Aviation Week

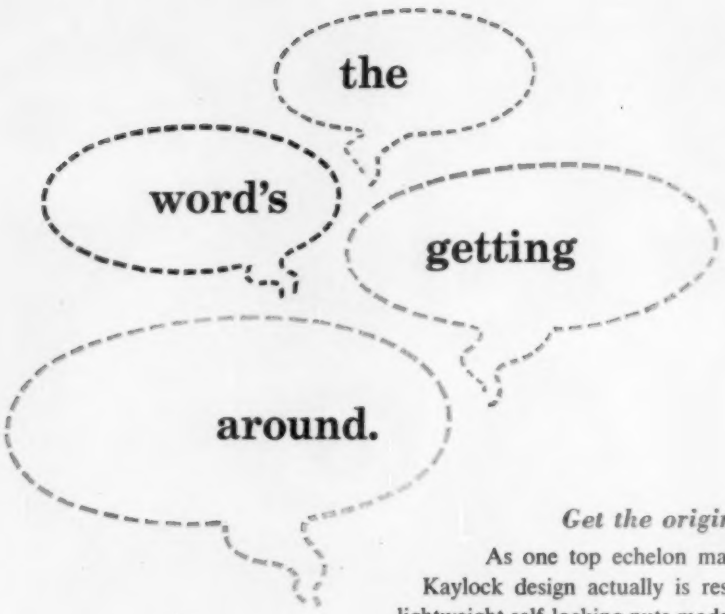
Including Space Technology

July 21, 1958

Missile Support Role Expanding

—

New Shape for Antenna Pushed



Get the original—by Kaylock

As one top echelon man put it just the other day, Kaylock design actually is responsible for every sale of all-metal, lightweight self-locking nuts made to an aircraft manufacturer today. We've never thought of it that way. But we do know this: Until the conception of the Kaylock design principle there was no such thing in America as an all-metal, lightweight, self-locking nut! Kaylock has shaved tons of dead weight from air-frame design. And make a note of this: It is taking its first step toward making the same contribution to engine makers. The new concept which has become standard with air-frame manufacturers will soon gain the same stature with engine designers. You should know about the new Kaylock hi-temp, high tensile 12-point self-locking nut. New today—it will be standard tomorrow.

Call your Kaylock consultant and ask him about it.

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All-metal self-locking nuts ®

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Canadian Distributor: Abercorn Aero Ltd., Montreal, Quebec. Or write: Executive Offices: Box 2001, Terminal Annex—Los Angeles 54, Calif.

TO SAFEGUARD sensitive radar installations from the elements, Goodyear Aircraft builds huge rigid radomes of structural plastic—*and they will be built in sizes in excess of one hundred feet in diameter.*

AIR TRANSPORTABLE! These mammoth spherical structures are created from modular plastic panels which can easily be flown, in quantity, to the desired location—and the radome assembled on the spot.

Close teamwork with M. I. T.'s famed Lincoln Laboratory results in the incorporation of the very latest concepts into production design.

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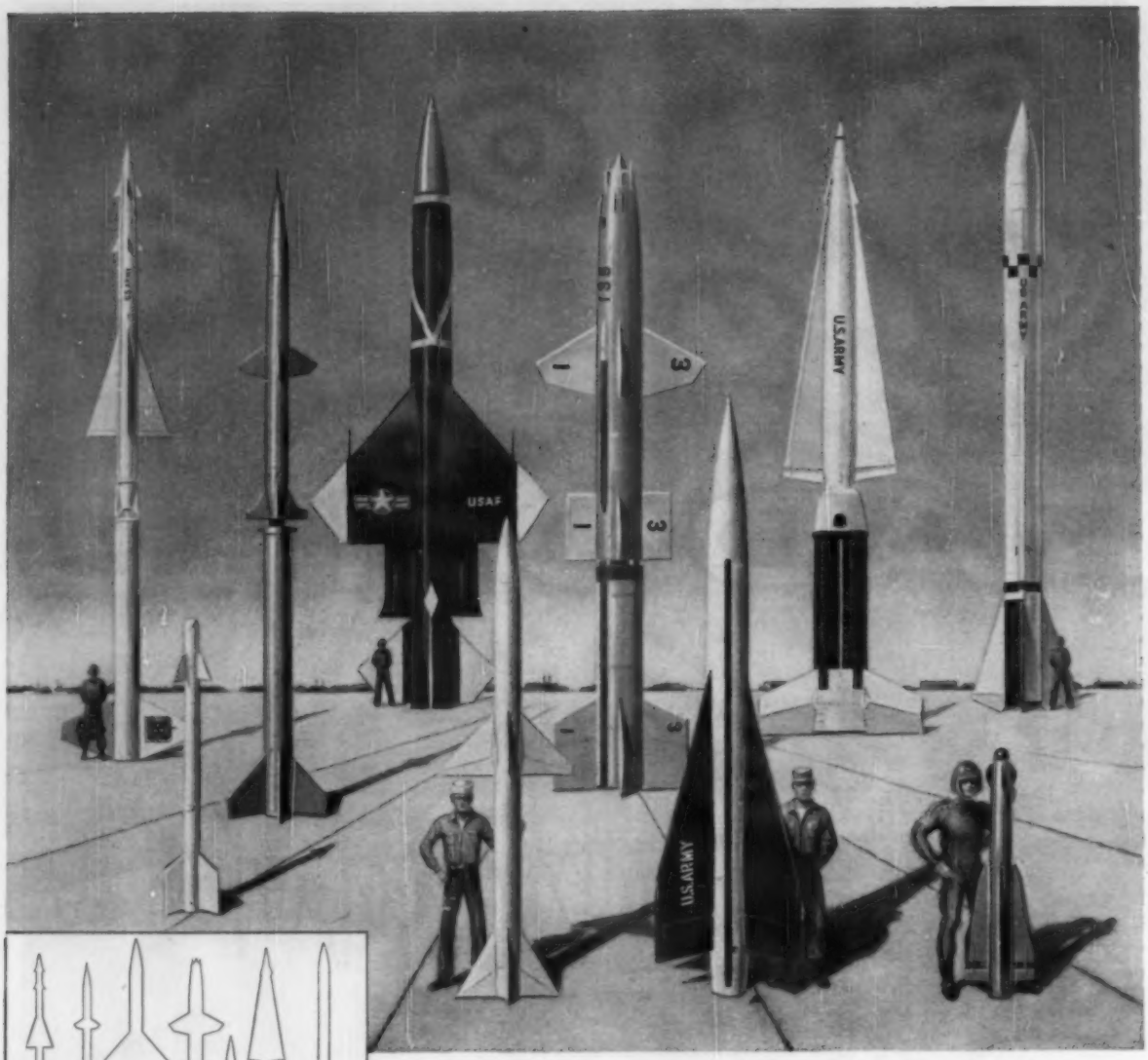
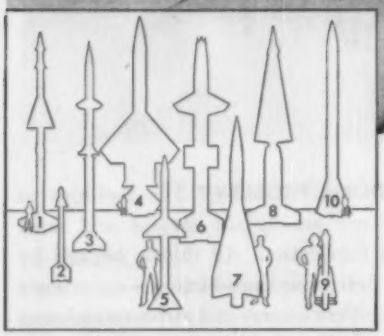
ENGINEERED PLASTICS—One of the Prime Capabilities of

GOODYEAR AIRCRAFT

Plants in Akron, Ohio, and Litchfield Park, Arizona





1. **Nike Ajax.** Army. Ground-to-air. Prime contractor: Western Electric.
2. **Sidewinder.** Navy. Air-to-air. Prime contractors: Philco; General Electric.
3. **Terrier.** Navy. Surface-to-air. Prime contractor: Convair.
4. **Bomarc.** Air Force. Ground-to-air. Prime contractor: Boeing.
5. **Sparrow III.** Navy. Air-to-air. Prime contractor: Raytheon.
6. **Talos.** Navy. Surface-to-air. Prime contractor: Bendix.
7. **Hawk.** Army and Marine Corps. Ground-to-air. Prime contractor: Raytheon.
8. **Nike Hercules.** Army. Ground-to-air. Prime contractor: Western Electric.
9. **Falcon.** Air Force. Air-to-air. Prime contractor: Hughes Aircraft.
10. **Corporal.** Army. Ground-to-ground. Prime contractor: Firestone.

10 MAJOR U. S. MISSILES RELY ON RAYTHEON TUBES

Crushing acceleration and searing heat must be endured by the electronic tubes in guided missiles. Even under these grueling conditions, tiny Raytheon tubes produce guidance impulses with steadfast *reliability*. This reliability is achieved through capable engineering and painstaking manufacturing and testing techniques.

The choice of Raytheon Reliable subminiature tubes for use in these 10 missiles is another example of how the 30,000 men and women of Raytheon are contributing to the nation's security.

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RAYTHEON MANUFACTURING COMPANY, Waltham, Mass.

AVIATION CALENDAR

Aug. 5—Regional Technical Meeting on Space Exploration, sponsored by American Rocket Society and the Institute of the Aeronautical Sciences. For details R. D. Linnell, General Chairman, Space Exploration Meeting, 3300 N. Harbor Drive, San Diego 1, Calif.

Aug. 6-8—Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.

Aug. 7-8—Annual Conference, American Society for Quality Control, Western Region, El Cortez Hotel, San Diego, Calif.

Aug. 7-9—National Convention, OX5 Club of America, Hotel Statler, Los Angeles, Calif.

Aug. 7-15—Modern Developments in Heat Transfer, Continuation Course, University of Minnesota, Minneapolis, Minn.

Aug. 13-15—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder Laboratories, Boulder, Colo. Sponsored by NBS, American Institute of Electrical Engineers and Institute of Radio Engineers.

Aug. 13-15—Seventh Annual Conference, Industrial Applications of X-ray Analysis, Albany Hotel, Denver, Colo.

Aug. 17-23—Missiles Operations Research, Engineering Seminar, Pennsylvania State University, University Park, Pa.

Aug. 18-19—Annual Western Regional Meeting, American Astronautical Society, Dinkelspeil Auditorium, Stanford University, Palo Alto, Calif.

Aug. 18-20—Second National Heat Transfer Conference and Exposition, Edgewater Beach Hotel, Chicago, Ill.

Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

(Continued on page 6)

AVIATION WEEK Including Space Technology

July 21, 1958
Vol. 69, No. 3

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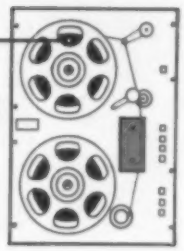
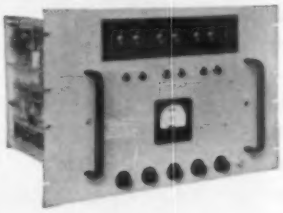


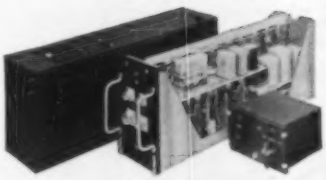
IN ANALOG DATA REDUCTION SYSTEMS

Three companion units by Hycon Eastern provide automatic indexing and high-speed access to selected data in multi-channel magnetic tape instrumentation systems.



For Tape Indexing

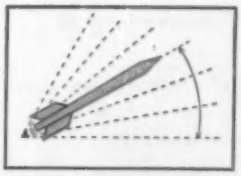
DIGITAL TIMING GENERATOR, MODEL 201, generates numerically coded timing signals which are recorded on magnetic tape throughout the data recording periods, providing a precise digital index in terms of elapsed time. The Generator also visually displays the exact time in hours, minutes and seconds as illuminated digits.



DIGITAL TIMING GENERATOR, MODEL 206A, FOR AIRBORNE APPLICATIONS is a militarized version of Model 201. A Remote Control Box contains Power off-Standby-Operate Switch, the Digital Clock Set, and the Time Display. Completely transistorized, Model 206A includes a binary coded decimal system although other timing formats are available to meet customer requirements. Weighing only 15 pounds, Model 206A is stable to 1 part in 100,000 giving an accuracy of ± 1 second in 1 day's time.

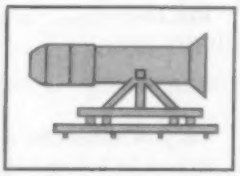
For Tape Search

MAGNETIC TAPE SEARCH UNIT, MODEL 202, operates during data reduction periods. On the basis of time indices recorded on the tape by the Digital Timing Generator, this instrument automatically locates and selects for controlled playback the tape data included between a "sequence start time" and a "sequence end time" specified by panel dial settings. The time index is visually displayed as illuminated digits on a small separate panel which may be remotely located for convenience. Model 202 may be modified to search for timing formats other than those originated by Model 201.



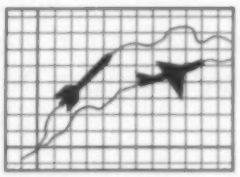
WIND TUNNEL TESTING

Pressure and temperature data of missiles are referenced to angle of attack. Model 201 records on tape a digitized position signal for each new angle of attack.



JET ENGINE TESTING

Digital Timing Generator, Model 201 synchronizes all data receiving equipment. Its output can be piped to multiple test cells and control rooms simultaneously.



MISSILE AND AIRCRAFT TESTING

Model 206A generates timing signals simultaneously with other flight test data. Model 201 generates a timing code format for synchronizing ground station recordings.

Write for Technical Bulletin TSG

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58-18

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SENSITIVITY:..... 105 mv/in/sec ±5%
RESPONSE:..... Flat ±10% from 50 to 500 cps
MAX. AMPLITUDE: . 0.12 in. double amplitude
TEMP. RANGE: .... −65° to +500°F
CONSTRUCTION: .. Aluminum, heat-resistant finish

Call your nearest CEC sales and service office, or write for Bulletin CEC 1535-X25 (which contains complete specs, nomograph, drawings, etc., and is a pretty useful piece of paper).

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RECOGNIZED LEADER IN GALVANOMETERS—TELEMETRY, PRESSURE AND VIBRATION INSTRUMENTATION

AVIATION CALENDAR

(*Continued from page 5*)

Aug. 25-27—Third Annual Convention, National Flying Club Assn., Hollwood Roosevelt Hotel, Hollywood, Calif.

Aug. 25-30—Ninth Annual Congress, International Astronautical Federation, Amsterdam, Holland.

Aug. 31-Sept. 1—Air Race, Professional Race Pilots Assn., Ft. Wayne, Ind. For details: Don Berliner, 19 Hudson Ave., Athens, Ohio.

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 2-12—Problems of High-Powered Radar Design, Summer Program, Massachusetts Institute of Technology, Cambridge, Mass. (Security clearance required.)

Sept. 3-5—1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.

Sept. 9-11—Second National Conference on Applied Meteorology: Engineering, Ann Arbor, Mich. Program Chairman: Dr. D. J. Portman, 5500 East Engineering Bldg., University of Michigan, Ann Arbor, Mich.

Sept. 11-12—Annual Business Meeting and Conference, Northeast Chapter American Assn. of Airport Executives, Municipal Airport, Worcester, Mass.

Sept. 15-18—Fall Meeting, American Rocket Society, Inc., Hotel Statler, Detroit.

Sept. 15-19—Annual Instrument-Automation Conference & Exhibit (International), Instrument Society of America, Philadelphia Convention Hall, Philadelphia, Pa.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, American Hotel, Bal Harbor, Miami Beach, Fla.

Sept. 22-24—Seventh Annual Meeting, Standards Engineers Society, Benjamin Franklin Hotel, Philadelphia, Pa.

Sept. 22-24—1958 Convention of the National Business Aircraft Assn., Bellevue Stratford Hotel, Philadelphia, Pa.

Sept. 25-27—Fifth Annual National Western Forum, American Helicopter Society, Ambassador Hotel, Los Angeles, Calif.

Sept. 29-Oct. 3—National Aeronautical Meeting, Society of Automotive Engineers, Inc., the Ambassador, Los Angeles.

Sept. 29-Oct. 3—Semi-Annual Meeting and Western Tool Show, American Society of Tool Engineers, Shrine Exposition Hall, Los Angeles, Calif.

Oct 1-3—National Airports Conference, University of Oklahoma, Norman, Okla. Co-sponsored by American Assn. of Airport executives and the Civil Aeronautics Administration.

Oct. 7-8—1958 Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Chateau Laurier, Ottawa, Canada.

Oct. 22-24—Fifth National Vacuum Symposium, Sir Francis Drake Hotel, San Francisco, Calif.

Oct. 27-28—East Coast Conference on Aeronautical & Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

all the way

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July 21, 1958

Aviation Week

Including Space Technology

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► Capitol Hill approves proposal for nation's first space agency; nucleus to be established by NACA.

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► American leads opposition to present regulation; final decision scheduled to be made in November.

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► SVE antenna concept said to reduce volume swept by rotating antennas, may have space platform communication uses.

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COVER: Antenna is a model of a satellite tracking array that at full size would consist of two 60 ft. spars mounting 24 cigar-type elements to obtain a 1.2 deg. pencil beam in the UHF band. Antenna would have same gain, beam width and side lobe level as a comparable sized conventional parabolic antenna. Satellite tracking problem would be solved by employing all antenna elements to provide a high gain, low side lobe level condition for acquisition, and a very narrow beam with reduced gain by switching off the feed networks of approximately one-half the elements for tracking.

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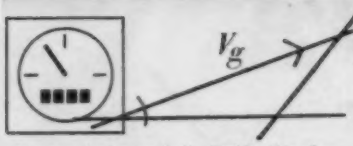

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RADAN joins the jet crew

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RADAN navigators are members of the famed GPL family of Doppler systems developed in conjunction with the USAF (WADC). GPL auto-navigators have literally revolutionized flight. They are the only self-contained systems in the world proved over millions of operational miles.

Recent release of RADAN Systems for civilian use now makes their benefits available to everyone. RADAN saves time and precious fuel for the air lines, provides a priceless margin of safety for all.

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EDITORIAL

Both Horns of the Dilemma

Soviet policy for the last decade has been aimed at the twin objectives of weakening the U.S. military and economic power. With the crisis in the Middle East providing a sharp focus on our current situation, it is sad to record how this country is moving along both paths so ardently desired by our mortal enemies. The two horns of the dilemma in which the Soviets hope to entrap us are already beginning to pinch perceptibly.

First, let us look at the relative military positions of the U.S. and the Soviet Union. A decade ago, even with military budget cuts that were already beginning to erode the sources of this power, we were supreme with the atomic weapon and an intercontinental aerial delivery system—the Convair B-36. Today, we find ourselves in a position where the question of whether we have any significant military superiority left is an unresolved matter of national debate. We have seen the Soviets draw almost abreast in jet fighters and long-range bombers, forge slightly ahead in jet transport development and take a lead in the development of ballistic missiles of both intermediate and intercontinental range.

Pentagon Soothing Syrup

The Soviets' 4,000-mile firings of a complete ICBM that began last August are a matter of undisputed record. In contrast, despite a great deal of soothing syrup and half truths dispensed by top Pentagon spokesmen, we have not yet fired an Atlas, the first of our ICBMs, with all of its propulsion units operating. Nor have we completed a full range test of the operational Atlas weapon system. In the IRBM field, we are lagging even more. No amount of hair-splitting sophistry by Donald Quarles, Under Secretary of Defense, over whether an IRBM must travel 1,500 miles to qualify for the title and is disqualified if its range is only 1,400 miles can alter this grim fact.

It is true that the destructive power of our weapons has increased enormously until a single F-100 type fighter can deliver a megaton bomb and a single B-52 can unload at least 20 megatons on a single mission. But this progress has been generally matched by similar Soviet advances. Again there is incontrovertible evidence that the Russians were the first to actually test a hydrogen bomb dropped from an aircraft and the first to detonate atomic missile warheads at high altitudes in operational tests.

Shrinking Force Levels

Meanwhile, the size of our forces in being have constantly shrunk. Army, Navy and Air Force have been subjected to constantly reduced force levels since the end of the Korean war. With the critical emphasis on forces in being that a nuclear war demands, it is hard to conceive the logic that on the one hand proclaims our firm commitment to use nuclear weapons against any aggressor and on the other hand reduces the forces in being on which this type of conflict would depend.

The race in outer space exploration, while its military value may still be many years from fruition, offers another example of how we are carelessly mortgaging our nation's future in the professed interest of "economy." Even more saddening, is listening to our official apologists of the U.S. Information Service try to explain this deficiency to neutrals and our allies abroad. Few of our friends abroad are being fooled by this transparent tissue of wishful thinking, and their respect for our ability and integrity shrinks accordingly.

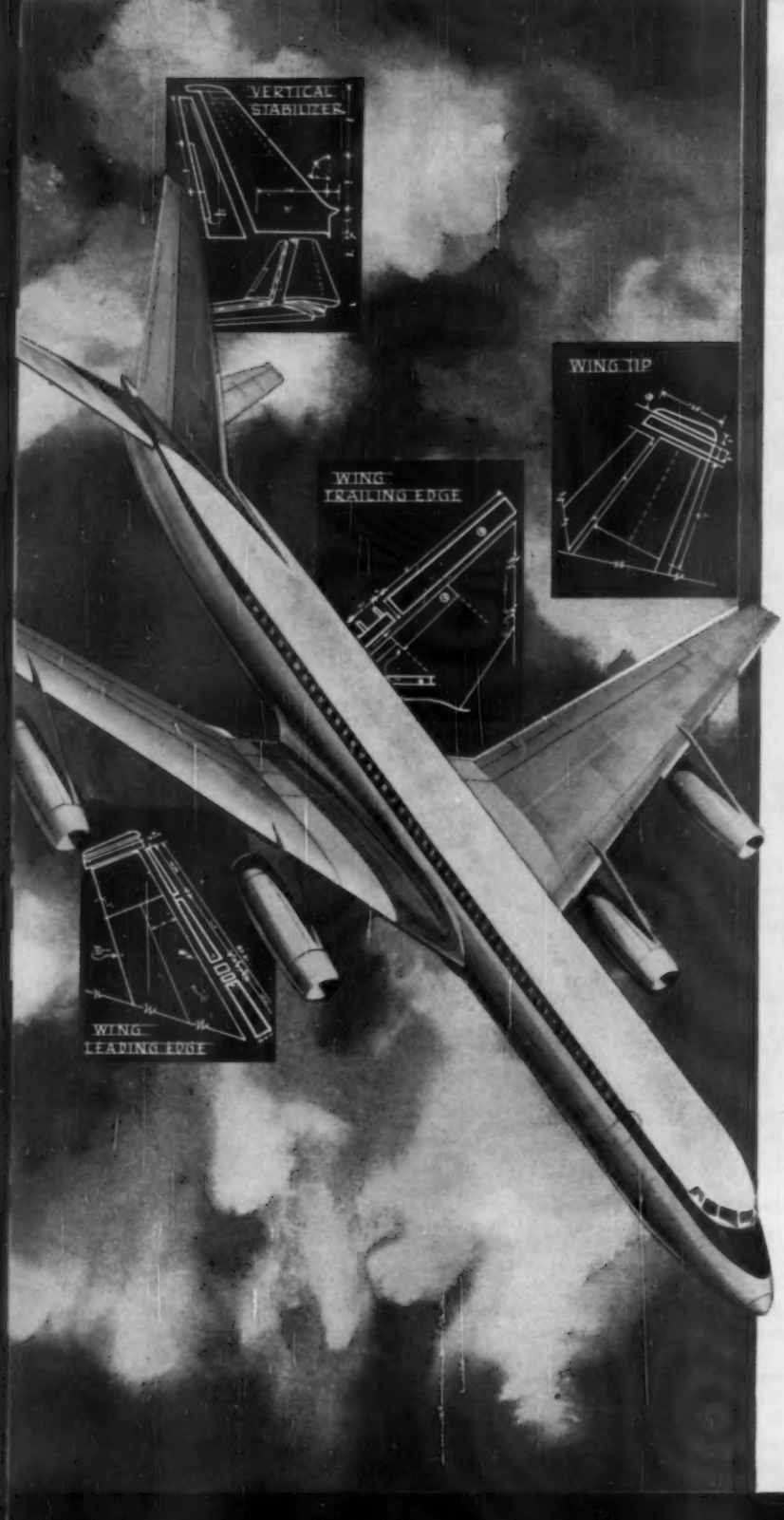
Almost eight years to the month after President Truman made the decision to resist Soviet aggression in Korea with armed force, we find ourselves on the brink of a similar situation in the Middle East. In the meantime, we have been pursuing a phantom abstraction of peace and reducing the relative strength of our military power while all around the world armed Communists were gobbling up new slices of territory and new peoples under one pretext or another. We should now see clearly how futile it has been to prate moral platitudes while we possessed neither the armed might to enforce them nor the determination to aid our allies against their enemies.

False Doctrine

So, in a decade we have gone from a position of unchallenged military superiority to a position that is certainly challengeable and where any over-all margin of our superiority that may remain is hardly perceptible. Even more significant is the fact that the forces that have reduced our military power over the last decade are still in motion. As each day passes, we are growing weaker, not stronger. We are not only shrinking from the cost of maintaining adequate land, sea and airpower in being, but we are failing miserably to make sufficient investment in research and development that is required to ensure our future.

What many people do not understand is that the results of this determined and consistent effort to reduce our military power is also at the root of our current economic troubles. It has been a doctrine preached by all the advocates of reduced military strength that "we cannot afford" adequate military power and that maintaining it "will spend us into bankruptcy." The simple truth of the matter, as proved by events of the past year, is that the exact opposite is true. When the foundations of the defense structure were severely shaken by radical new government fiscal policies last summer, the tremors were transmitted to the foundations of the entire economy. They opened the cracks that have widened into the current recession. Thus, we are now being gored by both horns of a dilemma which is weakening our military power and sapping our economic strength.

—Robert Hotz



Crosley helps CONVAIR Jet 880 to keep a date

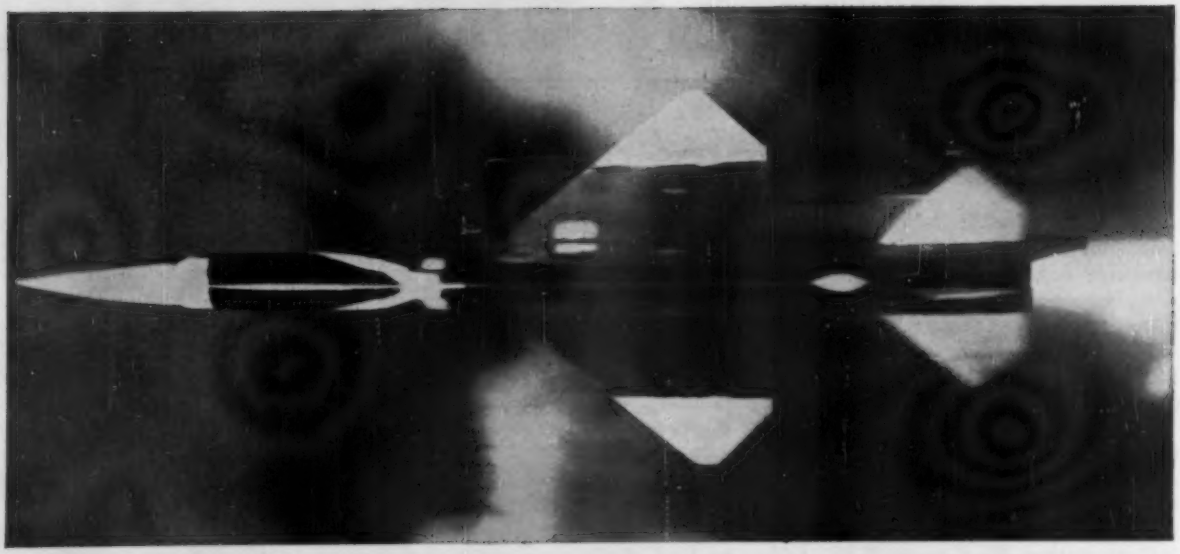
Soon the Convair Jet 880 will take to the skies as one of the world's fastest jetliners. Sleek, smooth and strong—the luxurious jet will race the sun at 615 miles per hour!

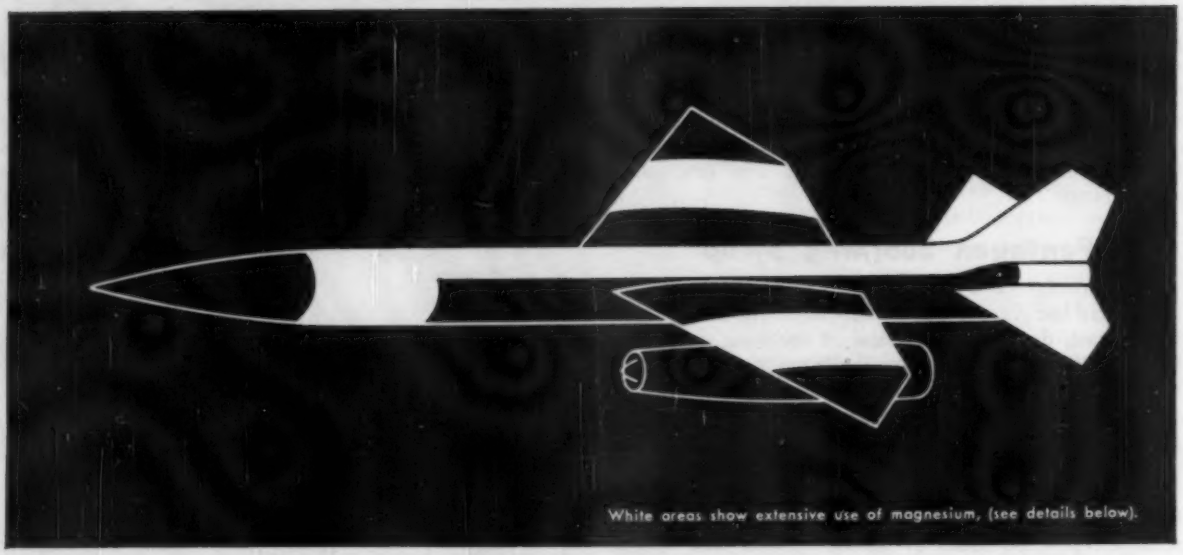
Convair has chosen Crosley to design and produce many of the 880's components. And while actual construction progresses, a Crosley team of engineers is "on site" at the plant to help insure speedy transition from design to production to maiden flight date.

Crosley's contributions to airframe construction include all of the conventional types of assembly in addition to the newer methods of honeycomb, metal bond, and chem-milling. Equally important are Crosley's contributions to safety in flight, represented by such developments as Volscan—the electronic air traffic control system, or airborne navigation and communications equipment, embodying advanced concepts of electronic application.

For further information on Crosley's airframe and other capabilities write to the Vice President—Customer Relations, Avco Manufacturing Corporation, Crosley Division, 1329 Arlington Street, Cincinnati 25, Ohio.

Avco // Crosley





White areas show extensive use of magnesium, (see details below).

HOW ELEVATED-TEMPERATURE MAGNESIUM ALLOYS HELP BOMARC KEEP FIGHTING WEIGHT

Approximately 230 lbs. of magnesium is used in the airframe of the Bomarc, powerful surface-to-air missile. And for good reason: In each case, the specific application called for light weight and retention of strength, rigidity and other properties at elevated temperatures. The logical choice was sheet, extrusions or castings of elevated-temperature magnesium alloys.

EXAMPLES:

BODY. The body skin and doors of both nose and aft sections utilize 103 lbs. of HK31A sheet and castings. Resultant weight savings were 23 lbs., including a net reduction of 6 lbs. by using a magnesium casting for a door frame structure.

WING, FIN AND TAIL. 111 lbs. of HK31A sheet were used in the wing, elevators and elevator stubs, fin and rudder. All leading and trailing edges of control surfaces for wings and fin are HM31XA extrusions. Here another 8 lbs. were saved by using an elevated-temperature magnesium alloy.

These are but a few instances of how precious weight was saved in the Bomarc. For more information about the use of magnesium alloys in aircraft, rockets and missiles, contact the nearest Dow sales office or write directly to us. THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1407K-2.

YOU CAN DEPEND ON DOW

WHO'S WHERE

In the Front Office

Robert R. Miller and **Thomas V. Jones**, senior vice presidents, and **Richard R. Nolan** and **Irving Roth**, corporate vice president, Northrop Aviation, Inc., Hawthorne, Calif.

Charles H. Rodgers, vice president in charge of financial operations, Consolidated Diesel Electric Corp., Stamford, Conn.

Anthony F. Bisgood, chairman of the board, and **Charles A. Tepper**, president, Industro Transistor Corp., Long Island City, N. Y.

Charles W. Sinclair, vice president-engineering, Kelsey-Hayes Co., Detroit, Mich.

International Telephone and Telegraph Corp., New York, N. Y., elected the following five men vice presidents in its Consolidated Laboratories Section: **Louis A. de Rosa**, Electronic Countermeasures; **Sven H. Dodington**, Avionics; **Armig G. Kandoian**, Communications Systems; **Arnold M. Levine**, Missile Systems; and **Dr. Charles D. W. Thornton**, Physical Sciences, Components and Instrumentation.

Honors and Elections

Scott Crossfield, North American Aviation test pilot, has been awarded the 1958 Octave Chanute Award in Los Angeles, Calif. for "significant and extended contributions to the study of human factors involved in flight at extremely high speeds and altitudes."

A. F. Logan, vice president-labor relations of Boeing Airplane Co., has been appointed to the Management Advisory Committee on Wage Stabilization of the U. S. Department of Labor. Mr. Logan is the only representative from the aircraft industry on the committee.

T. C. Coleman, president, Coleman Engineering Corp., has been elected president and board chairman of the Strategic Industries Assn.

Dr. Paul J. Sandiford, director of operations research, Trans-Canada Air Lines, has been named to serve on the International Co-operations Committee of the Operations Research Society.

Louis F. Polk, vice president, Bendix Aviation Corp., has received an honorary doctor of science degree from Miami University, Oxford, Ohio, for his ". . . contributions in advancing the art of engineering and meterology."

Changes

Turner A. Sims, Washington representative, Pratt & Whitney Aircraft Division, United Aircraft Corp.

R. W. Cook, director of administration, Government Products Group, American Machine & Foundry Co., Alexandria, Va.

Douglas J. Hocker, applications engineer, Military Contracts Division, Singer Manufacturing Co., Bridgeport, Conn.

G. H. Rathe, manager of marketing, Military Products Division, International Business Machines Corp., New York, N. Y.

John M. S. Hutchinson, staff assistant to the president, Bendix Aviation Corp., Detroit, Mich.

INDUSTRY OBSERVER

► Airways Modernization Board, at Defense Department request, is attempting to resolve the military-airline controversy over Doppler radar operating frequency (AW June 30, p. 28). AMB will begin tests to determine how serious an interference problem will exist between airborne Doppler radars and ground-based air defense radars if airlines are allowed to operate Doppler systems at 8,800 mc.

► **Japanese Air Force is evaluating fire control system proposals in connection with the Grumman F11F-1F. U. S. manufacturers who are vying for a contract to supply the installation include Hughes Aircraft, Westinghouse, Packard-Bell, Radio Corp. of America and North American's Autonetics Division.**

► Contract eventually totalling about $10 million will be awarded within the next few months for very large, pencil beam parabolic antennas and pedestals for installation at the three far north sites of USAF's ballistic missile early warning system for tracking incoming Soviet intercontinental ballistic missiles. Parabolas will be approximately 100 ft. in diameter, have a beam-width of approximately two degrees and employ a complex feed system resembling an organ-pipe feed to provide switched bandwidth capability extending from VHF through S-band. Probably two tracking radars will be required at each site. They will have surveillance capability so that a tracking radar can substitute for a surveillance radar that is inoperative. Likely bidders include American Machine and Foundry, Blaw-Knox, GB Electronics and D. S. Kennedy.

► **United Aircraft Corp.'s recently-organized Missiles and Space Systems Division is moving rapidly to capture its share of the market. Division already has proposed a satellite with a 100-ton payload to the Defense Department.**

► Capabilities of University of Southern California engineering center's two phase wind tunnel will be extended to Mach 20 within the next year. Present capability of the tunnel, which is under the sponsorship of the Office of Naval Research and the Air Force Office of Scientific Research, is Mach 8 to 10. Altitude of 300,000 ft. can be maintained for approximately 10 hours. Continuous flow tunnel can be used for ICBM studies. Tunnel is housed in a vacuum tank 30 ft. long and nine ft. in diameter.

► **Russians recently failed in an attempt to place their fourth satellite into orbit.**

► Piper Aircraft's new agricultural airplane designed to replace its high-wing PA-18-A is expected to receive CAA certification by the end of the year and be available to customers in 1959. Piper aims to keep the price similar to that of the Super Cub which sells for approximately $7,300.

► **Air Force apparently has abandoned proposals to base some Titan intercontinental ballistic missiles on "soft" sites above ground, others in "hard" sites below ground. Present plans call for all Titan bases to be located underground.**

► General Electric's Aircraft Gas Turbine Division notes that on one day in June there were five military vehicles in the air simultaneously in various parts of the U. S. flying at Mach 2 and powered by the company's J79 turbojet engine. The aircraft were the Convair B-58, Chance Vought Regulus II missile, Lockheed F-104, Grumman F11F-1F and McDonnell F4H.

► **Lulka bypass engine is shown in a sketch at the air museum in Moscow. Sketch shows a single-stage fan, a single-stage turbine and a relatively low bypass ratio. Russians say sketch is only a "schematic" but that such an engine has been built.**

► Russia's 26 planetariums are doing a land-office business giving lectures on the Sputnik launchings. One of the best, located at Stalingrad and equipped with East German projection equipment, gives a popular lecture every hour for four hours running each afternoon. Lecturer correctly credits U. S. with three satellites, Russia with only one, and makes no mention of the greater size of the Soviet vehicles.

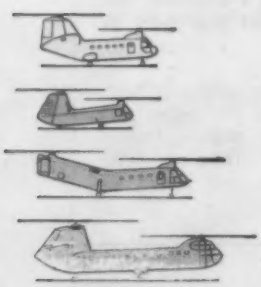
Twin-turbine VERTOL 107
tomorrow's helicopter—flying today

Missile launcher is flown into a remote location ... then the missiles are hoisted into position and fired. Immediate departure to new location evades counter fire.

The new twin-turbine Vertol 107 (U. S. Army designation: YHC-1) has the high speed and brute lifting ability to do the work of two piston-powered helicopters of similar size. Its design is based upon careful study of the needs of military and commercial operators, with the result that the Vertol 107 has these significant new features:

- *All-Weather operation.* First transport helicopter to be flown that was designed from the start for IFR flight.
- *Rear loading.* Ample headroom over the ramp permits a jeep to be driven into the cabin. A cargo load too long to fit fully inside can be flown with the end projecting beyond the open rear door.
- *Short fuselage, big cabin.* The Vertol 107 is ten feet shorter than the piston-powered H-21 but the cabin is higher, wider and longer, providing substantially more space for passengers or cargo.
- *Ease of Maintenance.* Engines, control system, fuel system, transmission system are accessible from the outside without entering cabin.
- *New safety standards.* In addition to twin-engine dependability, the Vertol 107 provides inherent stability, fuel tanks *outside* the cabin in stub wings, and the best pilot visibility yet in a transport helicopter.

Because of these and many other new features, the Vertol 107 is ideally suited to a multitude of military missions, and it will be available commercially by 1961. The Model 107 is truly tomorrow's helicopter—and a prototype has been flying since April.



VERTOL *Aircraft Corporation*

MORTON, PENNSYLVANIA

SUBSIDIARY: ALLIED RESEARCH ASSOCIATES, INC.

Washington Roundup

Defense Reorganization

Outlook is that the Senate will follow the House example and balk at giving Assistant Secretaries of Defense a free rein to give orders within the military services. The legislation providing for reorganization of Defense Department is due for action on the Senate floor this week.

In approving the measure last week, Senate Armed Services Committee wrote in a provision which would require the assistant secretaries to obtain delegated authority from the Secretary of Defense and to exercise this authority through the service secretaries.

Defense Secretary Neil McElroy, however, strongly urged command authority for the assistant secretaries over the service secretaries without specific authorization from the Defense Secretary (AW June 23, p. 22).

The armed services group did insert language stating that the Secretary of Defense is absolute boss over the entire military establishment. The Senate committee also went along with the House in placing strings on the Defense Secretary in making changes in "major" combatant functions. One member of the Joint Chiefs of Staff could decide a function "major," thus making any change in it subject to veto by Congress. The main objective: to assure that the Marine Corps and naval aviation would not be arbitrarily abolished by a Defense Secretary.

Space Committees

It will be necessary for the Senate to amend its rules before it can approve a Standing Committee on Aeronautical and Space Sciences, since Senators generally cannot serve on more than two standing committees except certain specified committees.

A resolution has already been introduced by Sen. Lyndon B. Johnson (D.-Tex.) and Sen. Styles Bridges (R.-N. H.) which would create a 15-man standing committee on aeronautics and space sciences and add the committee to the list of those whose members could serve on three standing committees.

A resolution is pending in the House which would create an "across the board" standing committee along the same lines. Purpose of both committees, when approved, will be to survey and review aeronautical and space activities of the National Aeronautic and Space Administration, authorized by Congress last week (see page 18).

USAF, Navy Obligations

USAF and Navy obligations for aircraft and related procurement contracts during the first eleven months of Fiscal 1958 approximated the amount for the same Fiscal 1957 period—$8.6 billion.

- **USAF obligations lagged,** $6.6 billion as compared with $6.7 billion for the Fiscal 1957 period.
- **Navy obligations were $2 billion** as compared with $1.9 billion for Fiscal 1957.

Expenditures for aircraft and related procurement during the eleven month period were substantially up. A total of $9.1 billion as compared with $8.5 billion for Fiscal 1957.

USAF expenditures were up from $6.6 billion for the Fiscal 1957 period to $6.9 billion. Navy expenditures of $2.2 billion compared with $1.9 billion for Fiscal 1957.

MATS Debate

There is a growing indication that Congress may act by next year on legislation that would guarantee a share of the government transportation business to commercial airlines unless the Military Air Transport Service voluntarily turns over more traffic to commercial carriers in the meantime. Airlines have long charged that MATS has been running an airline-type operation in competition with commercial carriers instead of performing its basic role.

If legislation is introduced during the next session of Congress, it has been hinted that it might be along the lines of the Maritime Act formula which gives the shipping industry 50% of government business.

Holloman Charge

Witnesses before the Senate Military Appropriations Subcommittee charge that the Air Force Missile Development Center, Holloman AFB, N. M., is the object of discrimination.

Daniel R. Brenton, representing Alamogordo, N. M., told the subcommittee that the government has invested more than $150 million in perfecting a highly-instrumented land range at Holloman and is now duplicating these facilities, or supporting private industry, to duplicate them elsewhere.

Brenton said:

"If the facilities at Holloman had been used to statically test the Vanguard and other doomed satellite rockets, they could have been proven out previous to firing, saving the taxpayers of America millions of dollars and such national embarrassment and humiliation as this nation has never before experienced, and the well-bred mouse would have been found several days ago."

Others expressing concern over Holloman include Sen. Clinton P. Anderson (D.-N.M.) and Sen. Dennis Chavez (D.-N. M.), subcommittee chairman.

National Air Museum

Congressional approval of a bill authorizing a National Air Museum for Washington does not appear likely this session due to a controversy in the House over where to locate the building.

The Senate approved a measure authorizing construction of a building for this purpose, but the bill has become stalled in the House where arguments continue over whether to use the old Pension building, construct a new building in the District or locate the museum in nearby Maryland.

AMB Change

Lt. Col. Carl B. Fisher (USAF) has been named acting deputy technical director of the Airways Modernization Board and will also serve as acting technical director, following the departure of James L. Anast to accept an executive position with Lear Inc. (AW June 23, p. 17). Prior to his new assignment, Fisher had been special assistant to AMB's Technical Director and project manager of the agency's data processing and display system program.

—Washington staff

NACA Wins Approval as Space Agency

Capitol Hill approves proposal for nation's first space agency; nucleus to be established by NACA.

By Ford Eastman

Washington—Forty-three-year-old National Advisory Committee for Aeronautics is preparing to evolve into the nation's first civil space agency, working directly with the President, on authority granted in legislation passed last week by both houses of Congress.

The new National Aeronautics and Space Administration, with NACA as its nucleus, will have jurisdiction over all civilian aeronautics and space activities, with the Defense Department retaining control over projects of military value.

The President is given responsibility for the over-all policy, plans and programs of the agency under the legislation which closely resembles recommendations originally presented to Congress by the chief executive. Formal presidential approval was expected.

In addition to establishing policy and developing a national space program, the President is given authority to determine which projects are military and which are civilian and to designate and fix responsibility for direction of aeronautical and space projects. He will be aided by a nine-member National Aeronautics and Space Council similar in status to the National Security Council.

The council will be composed of the President, who will preside over meetings, the Secretary of State, Defense Secretary, administrator of NASA, Atomic Energy Commission chairman, one additional member from the federal government and three from civilian life who are prominent in science, engineering, technology, education, administration or public affairs.

A government delegate can designate another officer of his department to serve as his alternate at meetings which he cannot attend. Appointment of an official alternate is subject to confirmation by the Senate.

The council will be permitted to employ a staff headed by a civilian executive secretary appointed by the President and subject to confirmation by the Senate at an annual salary of $20,000.

The bill represents a compromise between House and Senate versions of a National Space Act which differed sharply over the authority and power to be delegated to NASA and its administrator.

The House earlier had approved a measure placing control of the U.S. space program in a civilian agency headed by a single director and advised by a 17-man board as originally recommended by the President. The Senate version called for a seven-man policy board to plan and direct the space program and a civilian agency headed by a single director to operate under the Board's direction.

Both bills gave the President final authority over decisions.

President's Authority

Under the compromise bill however, the President has been given direct responsibility over the following duties:

- **"Survey significant aeronautical** and space activities, including the policies, plans, programs and accomplishments of all agencies of the U.S. engaged in such activities.
- **"Develop a comprehensive program** of aeronautical and space activities to be conducted by agencies of the United States.
- **"Designate and fix responsibility** for the direction of major aeronautical and space activities.
- **"Provide for effective cooperation** between the National Aeronautics and Space Administration and the Defense Department . . . and specify which of such activities may be carried on concurrently by both agencies, notwithstanding the assignment of primary responsibility therefore to one or the other of such agencies.
- **"Resolve differences arising** among departments and agencies of the U.S. with respect to aeronautical and space activities under the act, including differences as to whether a particular project is an aeronautical and space activity.

Responsibilities of NASA, under the compromise bill, are:

- **"Plan, direct and conduct** aeronautical and space activities.
- **"Arrange for participation** by the scientific community in planning scientific measurements and observations to be made through use of aeronautical and space vehicles and conduct or arrange for the conduct of such measurements and observations.
- **"Provide for the widest practicable** and appropriate dissemination of information concerning its activities and the results thereof."

In addition, the bill authorizes NASA to assume specific powers necessary to carry out its functions. These include authorizations to:

- **Acquire, operate and maintain** necessary laboratories, research and testing sites and facilities, aeronautical and space vehicles within or outside the continental U.S.
- **Accept unconditional gifts** or donations of services, money or property.
- **Enter in contracts, leases** or agreements for research and development of space projects and, where possible, enable small-business firms to participate equitably in the work.
- **Use, with their consent, services,** equipment, personnel and facilities of federal and other agencies which could aid the space program.
- **Appoint such advisory committees** deemed appropriate for purposes of consultation and advice.
- **Establish such offices and procedures** within the administration to provide for the greatest possible coordination of its activities with related scientific and other activities carried on by other public and private agencies.
- **Employ aliens, subject to security** investigations, without regard to statutory provisions prohibiting payment of compensation to aliens.
- **Employ retired commissioned** officers of the armed forces and compensate them at the rate established for the positions occupied by them within the administration.
- **With approval of the President,** enter into cooperative agreements under which members of the armed forces may be detailed by the service secretary to perform functions under the act to the same extent which they might be assigned in the Defense Department.
- **Settle damage claims** not to exceed $5,000.

Salary Scale

In creating NASA, the bill provides for the appointment of an administrator at an annual salary of $22,500 and a deputy administrator at a salary of $21,500. Both are to be appointed by the President and are subject to Senate confirmation.

The administrator is given authority to fill a maximum of 260 scientific engineering and administrative positions at a maximum salary of $19,000 a year. Ten of these positions could be compensated at $21,000 a year.

The administrator also may establish the civil service entrance grade for starting scientific and engineering personnel at a level two grades higher

than the grade provided for under the Classification Act.

Another provision of the bill provides for the creation of a Civilian-Military Liaison Committee to assure full and efficient coordination and cooperation between the civilian space administration and Defense Department. Chairman of the committee will be appointed by the President and subjected to confirmation by the Senate and will receive an annual salary of $20,000.

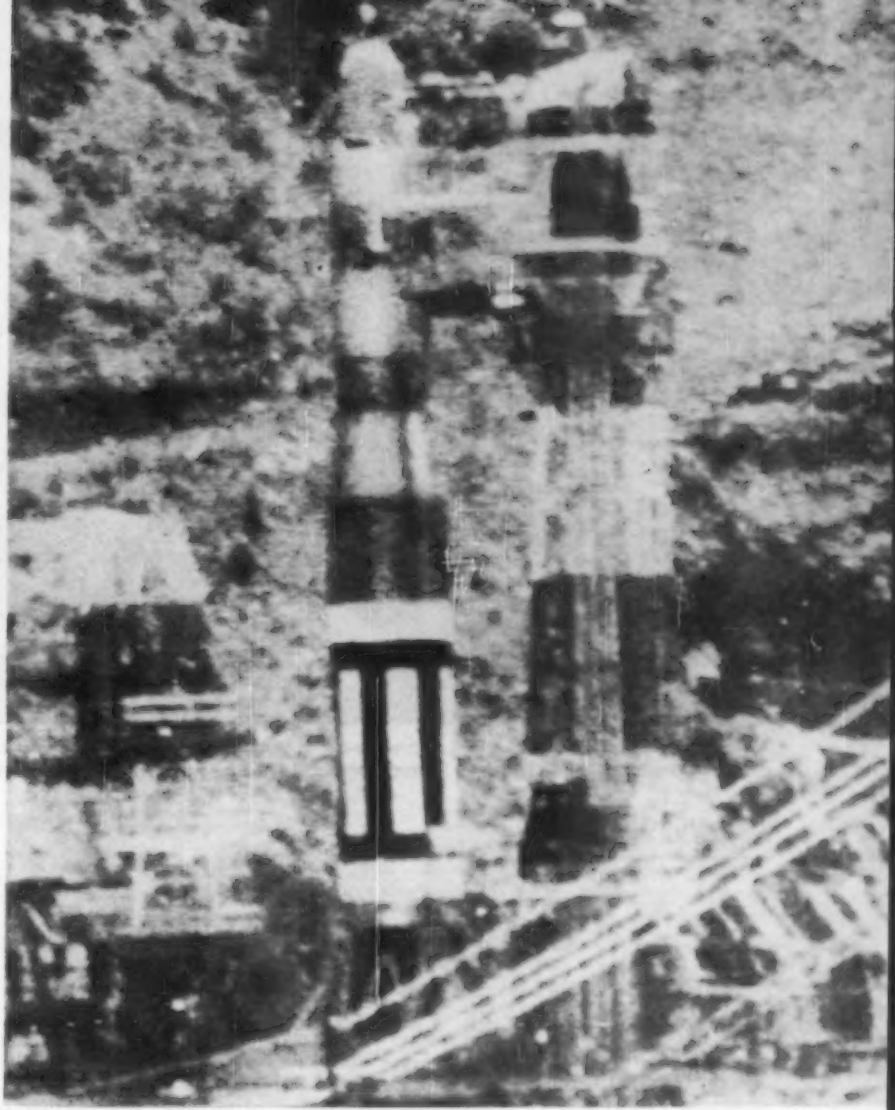
The committee will be composed of one or more representatives from the Defense Department and one or more from the Army, Navy and Air Force, plus an equal number from NASA.

Purpose of the committee is to permit the administration and Defense Department to advise and consult with each other on all matters within their respective jurisdictions relating to aeronautical and space activities and keep each other fully informed on their respective activities.

Patent provisions in the final bill were modified from previously approved provisions after industry strenuously objected on the basis that it gave all control to the government.

Under the new bill, flexibility was established in order to try and serve both public interest and the government and furnish incentives and initiative for private invention and discovery.

The bill passed by the Senate also called for a joint congressional committee, and a similar provision was eliminated by the House before approval of its version. The conference committee bill contained no mention of congressional committees, thereby permitting both the House and Senate to create its own committees.



Martin Ground-Tests Titan ICBM

First photo of USAF's Titan intercontinental ballistic missile was taken from five miles away. Picture shows the 5,500 mi. range missile undergoing static tests on battleship stand near the Martin Co. plant at Denver, Colo. Company has completed several ground tests and missile is expected to make first flight in October at Cape Canaveral, Fla. (AW Jan. 6, p. 23). Titan is 90-ft. long. Two stage liquid propellant rocket engines are built by Aerojet General Corp. (Copyright Metropolitan Television Co.)

Boeing Issue Sold; Douglas, NAA Report

New York—Boeing Airplane Co.'s offering of two debenture issues totaling $70 million was fairly successful last week with the bulk of the issue sold.

Boeing reduced the offering by $20 million just before the formal offering date, but did not postpone the entire issue as the Martin Co. did (AW July 7, p. 54). Financial sources said a decline in the government bond market had forced up corporation bond interest rates and while Boeing was willing to pay more than 5%, Martin was not.

Boeing's offering was in two parts, one a public offering of $40 million sinking fund debentures yielding 5.12% to maturity. This was planned as a $60 million offering. The other issue, $30,597,600 in 4% convertible debentures, was offered to stockholders only and was selling at a premium because the stockholder's purchase rights are salable and because of the conversion feature. Each $100 debenture is convertible to two shares of Boeing stock, quoted last week at around $45 a share.

Boeing will use the money in part to retire short term bank debt of more than $110 million.

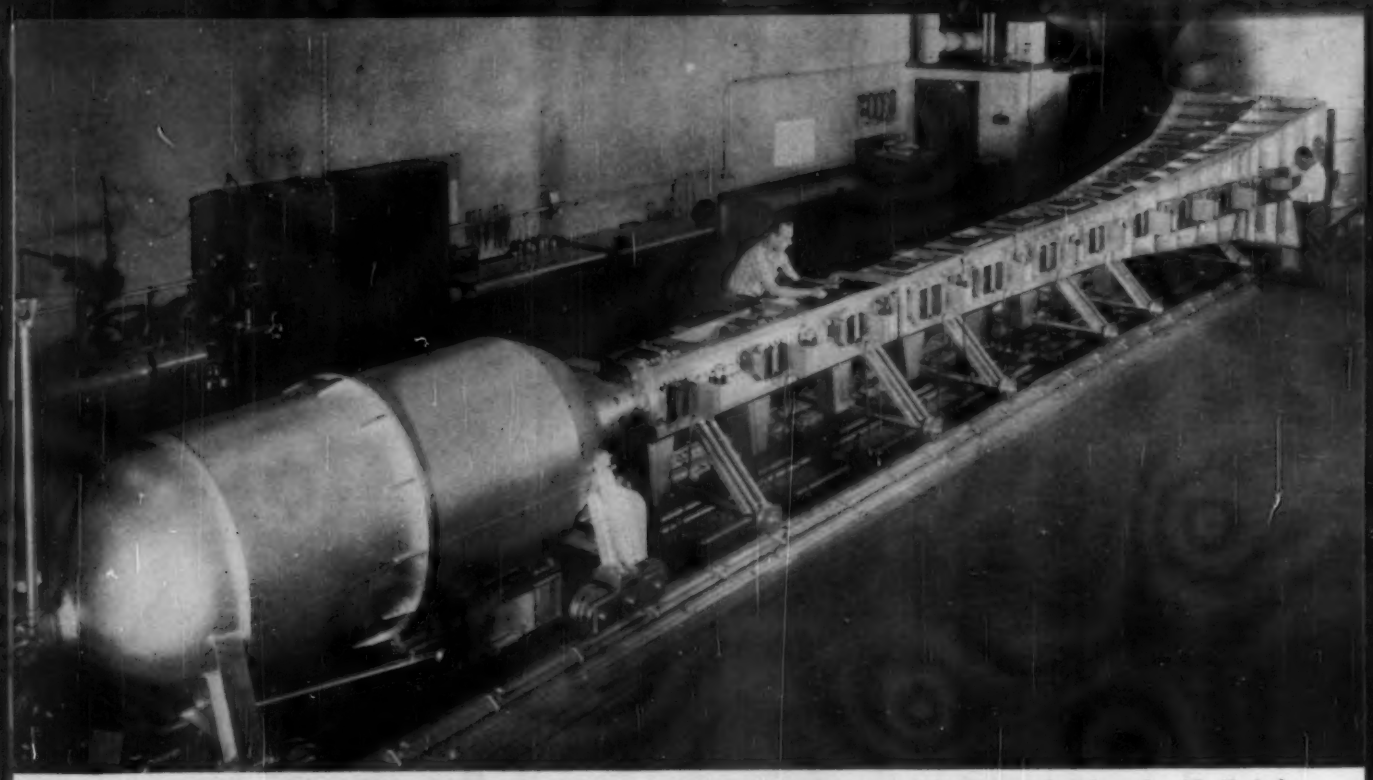
Other financial reports:

• **Douglas Aircraft's** first half earnings, under pressure from write-offs for the DC-8 commercial jet transport program, declined to $12,645,000 compared with $16,674,000 for the same period last year. DC-8 write-offs rose from $18 million last year to $27 million this year. Sales rose from $565,580,000 to $593,974,000.

• **North American Aviation's** net income for the first three quarters dropped from $26,604,000 or $3.32 a share last year to $18,223,000 or $2.27 a share this year. Sales also declined, from $937,095,267 to $678,879,646.

• **Piper Aircraft Corp.'s** sales picture showed signs of recovery in the third fiscal quarter. The 13.9% decline at the six-months mark was cut to 6% as of June 30, compared to like periods of Fiscal 1957, the company reports.

Sales as of June 30 totaled $20,245,210 compared to $21,523,508 for the nine months period of Fiscal 1957. Net income at the end of the current third quarter totaled $1,601,571 compared to $2,420,026.



ATMOSPHERE ENTRY SIMULATOR at Ames includes storage tank for high pressure air (left) trumpet shaped nozzle with 48 shadowgraph stations (center) which ends in a large pipe connected to a vacuum sphere outside the test chamber.

Space Technology

NACA Prepares for Expanded Mission

Moffett Field, Calif.—National Advisory Committee for Aeronautics' week of great change was marked by a display of its already extensive space research efforts at the triennial inspection of Ames Aeronautical Laboratory here last week.

As the 43-year-old agency prepared for the transition into the greatly expanded National Aeronautics and Space Agency, the mood was one of nostalgia. Dr. Hugh L. Dryden, Director, said this "may well be the last meeting of the NACA as such."

Dr. Smith J. Deffrance, director of Ames, told the 1,100 industry, military and congressional leaders attending the three-day event that space problems already are requiring 50% of NACA's research effort.

Dr. Dryden assured them, however, "that much work is being done on airplanes and missiles, including low speeds as well as high speeds, civil as well as military aircraft, and operating problems as well as advanced research." As examples he cited continuing ballistic nose cone work, research on USAF's Mach 3 B-70 bomber and studies that might someday lead to a 2,000 mph. transport.

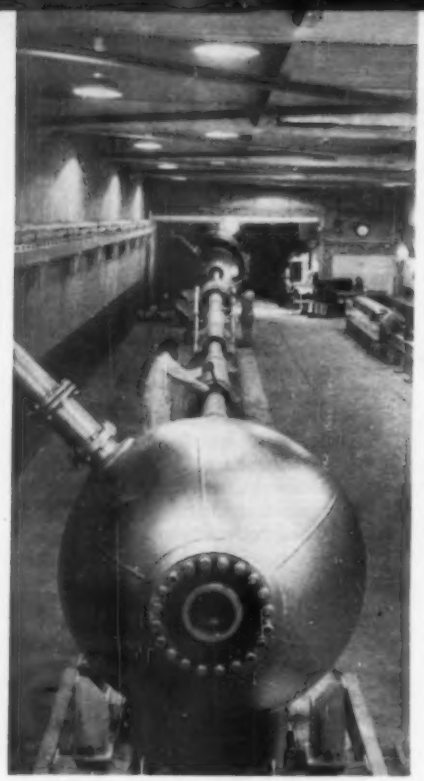
Space research areas highlighted:

- **Environment.**
- **Behavior of air** under the impact of vehicles moving through it at satellite speeds.
- **Control of attitude** and stability of satellites both in orbit and in re-entry.
- **Piloting control** problems.
- **Behavior of materials** at re-entry temperatures and use of aerodynamic design and cooling techniques to combat re-entry heating problems.
- **Investigation** of thermal-nuclear and nuclear-electric propulsion.

New facilities at Ames for the study of space flight include:

- **Hypersonic ballistic range** that can be used to simulate flight in atmospheres of earth and other planets at speeds up to 16,000 mph. Instrumented range is 500 ft. long. Models ¾ in. dia. are fired along the 8-ft. dia. chamber by a helium gun 200 ft. long. Gun is intended primarily for studies of aerodynamic heating at realistic atmosphere entry speeds. Air in the chamber is at rest, so models fly through air of uniform pressure, density and temperature. Air can be replaced by other gases to simulate atmospheres of other planets.
- **Atmosphere entry simulator.** A larger model of a simulator that began operating 18 months ago, this facility is used to determine total over-all effect of flight from above the atmosphere down to sea level, whereas hypersonic ballistic range is used to study effects of flight at selected pressures or altitudes.
- **Twenty-two caliber** models are fired from a special high-velocity gun into a small scale model of the atmosphere. Density variation of the atmosphere is simulated by releasing air from a high-pressure tank through a unique trumpet-shaped nozzle. The air expands in such a way that its density decreases just as atmosphere density decreases with altitude. Model therefore experiences in a few thousands of a second the decelerations, stresses, pressures and temperatures of actual entry.
- **Gun-fired models** in supersonic free-flight wind tunnel. Although this facility has been used for some time in such work as the ballistic missile and X-15 programs, it is now being applied to problems of safe recovery of satellites and to additional ballistic missile testing. Models are fired from small, smooth bore guns. Plastic sabots are used to adapt and align the model.

It will be especially for studies of



NEWEST Ames research tool is a light-gas gun for tests at speeds up to 16,000 mph.

in Space Age

glide vehicles that fly at nearly constant altitudes for extended periods.

Shock tube at Ames Laboratory produces air with temperatures of more than 25,000F for duplicating some of the conditions experienced by satellites and space vehicles entering the atmosphere.

Mixture of hydrogen and oxygen is exposed to heat and compressed helium in a combustion chamber. Diaphragm between combustion chamber and tube is ruptured and hot helium flows into tube at high speed and forms a shock wave. Air compressed by this shock blows through nozzle and past model, simulating heat and energy of air passing over vehicle traveling through atmosphere at speed. Flow lasts a few thousandths of a second, long enough to measure the rate at which the models heat.

In another presentation, Ames scientists demonstrated the use of a small ion beam accelerator to check the erosion of test specimens in a 15,000-mph. stream of charged particles. Copper models were found to be polished and pitted by the impact despite the relatively low mass of the particles. NACA has concluded, however, that ion erosion poses comparatively little difficulty. Ames accelerator uses nitrogen or oxygen ionized by radio frequencies propagated in a chamber evacuated to a pressure of one 1,000,000th of an atmosphere. Excitation of the aluminum test model by the ion stream caused it to emit radiation in the blue and ultraviolet bands of the spectrum.

Ionization of atmospheric particles by the incoming space ship may create a heating problem downstream due to the release of energy during recombination of the atoms. It also offers the opportunity of using magnetohydrodynamic techniques to deepen boundary layer and reduce friction heating. Conductive gas can be driven away from the skin by creating a magnetic field of proper polarity.

Re-Entry Attitude

Aspects of stability and control were outlined for orientation of satellites for such important phases as reconnaissance and proper re-entry attitude.

Proper combination of satellite spin rate and distribution of masses within the satellite would make it continue to point in one direction as it circles the earth.

Natural forces on a suitably designed non-spinning satellite will tend to keep one axis pointing toward earth. Using mass distribution of a dumbell shape as an example, it was shown that there will be minute differences in gravitational attraction on portions of the vehicle closest to and farthest from the earth. This difference in forces will tend to keep the longer axis pointed toward center of the earth.

If such a satellite were disturbed from this stable attitude, as it might during launching, it will oscillate slowly back and forth indefinitely in the manner of a frictionless pendulum. Feasibility of attitude control of manned satellite through use of principle of momentum was demonstrated with simple spinning flywheel to cause a simulated satellite to rotate in opposite direction.

Gyroscopic force used for control was shown with flywheel rotating in vertical plane. By turning the plane of rotation of the freely spinning wheel, direction of the satellite can be altered at will.

Use of small jets for rotating space craft was demonstrated by human activation and automatic "stable platform" similar to equipment used for inertial navigation of long-range planes, missiles and ships. In one application, as the simulated satellite was rotated, the stable platform activated air jets to drive the satellite back to its original position, illustrating how the body can be maintained in a fixed attitude despite disturbances.

Platform also was adapted to change the orientation of the satellite, as for keeping a reconnaissance system pointing continuously earthward, by being made to rotate at constant rate instead of maintaining its initial heading. Relative motion between the stable platform and satellite supplied electrical signal which operated air jets to bring the satellite along with the stable platform.

Scientists tackling pilot control problems at Ames through research with simulators have concluded that seat-of-the pants indications, once considered unreliable, provide good cues for the space pilot and are often necessary to good simulation. In one simulator programmed to confront the pilot with the control problem in atmospheric entry from 45-mi. altitude and 15,000 mph. speed to 13 mi. and 1,100 mph., scientists were obliged to complicate the equipment by imposing the true pitch and roll motions upon the pilot.

Simulated Entry

It was demonstrated that a pilot was capable of flying a simulated entry more smoothly and precisely with the vestibular and kinesthetic sensations created by these motions than with instrument references alone. NACA has found that pilots react more quickly to these traditional attitude cues than to visual inputs. Slow reaction tends to result in overcontrolling and the initiation of attitude oscillations which are difficult to damp with the low dynamic pressures at extreme altitude.

Analog computer-based equipment is capable of supplying variation of aerodynamic effects to suit variation in speed, altitude and control technique. The simulator is as useful for training as for research. Expense and hazard of early manned satellite and spacecraft flights demand a minimum number of test flights and virtually eliminates the possibility of training missions. As a trainer, a simulator must offer the pilot the same distraction he will meet in actual flight.

Ames scientists now are developing equipment to simulate high speed landing approaches and either parachute final descents or normal landings. Landing problem must include those created by the peculiar aerodynamics of vehicles intended to cope with the deceleration and heating of atmospheric entry.

A problem clarified by simulation of entry is the "skip" caused by a sudden increase in the effectiveness of aerody-

NACA Coverage

Triennial inspection of National Advisory Committee for Aeronautics' Ames Laboratory was covered by Aviation Week editorial team consisting of Irving Stone, Los Angeles bureau chief; Evert Clark, space technology editor, and Russell Hawkes, engineering editor.

namic surfaces at an altitude of about 35 mi. To this point, the pilot is absorbed with the task of maintaining a constant attitude without benefit of any aerodynamic effects. The exponential rise in atmospheric density with decreasing altitude then introduces problems before it offers much of a means of solution. Simulator flights show that coincident with a leveling off of the rate of descent, the pilot encounters difficulty in maintaining a five degree nose up attitude selected as a suitable one for entry. Skip recurs at lower altitude but is more controllable there.

Fine attitude control is essential. By holding it constant, the pilot is enabled to predict his landing point within 300 mi. This could be the difference between landing at Edwards AFB and landing in the Pacific Ocean since negligible range at low altitude will limit the possibility of correcting earlier errors.

To cope with severe problems of aerodynamic heating associated with re-entry vehicles, NACA researchers are investigating design and operational aspects of various surface cooling schemes including radiation, internal cooling, transpiration cooling, heat sink, ablation and conduction, as well as combinations of these methods.

In spite of the great amount of work already done on re-entry problems, additional facilities are required to extend research in this field. One of these installations, now being developed at Ames Laboratory, is a wind tunnel using helium to attain speeds up to Mach 26 to cover the critical range up to satellite speeds.

Pilot model of this facility is now under construction.

As a general premise, re-entry bodies should be blunt if heat absorption is to be minimized. Nevertheless, NACA researchers are continuing investigation of slender bodies because of their higher flight efficiency, despite adverse heating

SURFACE pitting by ionized gasses studied.

characteristics. Boost-glide vehicles must be slender to obtain long flight range and maneuverability in the atmosphere. Complicated methods of cooling may be required to make these shapes survive.

Chemical, thermal-nuclear and nuclear electric rockets were discussed as probable space propulsion systems by Lewis Flight Propulsion Laboratory personnel.

It was pointed out that for the high energy propellant combination of hydrogen and fluorine, theoretical values of specific impulse are a function of the percentage of hydrogen weight to total propellant weight. This yields two possible figures depending on whether expansion in the nozzle is "frozen" (dissociated and not recombined or "equilibrium" recombined).

Equilibrium expansion would produce specific impulse of about 460, while frozen expansion would result in a figure of about 430. Difference is due to heat released by recombination of the ionized propellant gases. A Lewis spokesman said research will be carried out to determine which type of expansion really occurs. A second factor in favor of equilibrium expansion is the fact that the optimum propellant combination requires that only 5-6% of total propellant weight be hydrogen, while frozen expansion requires that hydrogen be 15-19% of the total.

The Ames scientists presented the results of a study of 2,000 mph. long range airplane design. Airframe configurations shown were radical. Engine inlets, another key design problem, controlled shock wave positions by techniques very similar to those already in use in supersonic military airplanes of shorter range.

Turbojet engine efficiency rises continuously with speed and acceptable lift-drag ratios have been obtained at high subsonic speeds by use of thin, swept wings and careful design to minimize wing-body interference drag. These efforts and techniques were discovered or grew out of research in the past several decades, much of it done at the NACA Laboratories. Their intelligent use by the aircraft industry has made possible current high subsonic transports and bombers.

Long range planes capable of supersonic speed are a different problem because of the appearance of wave drag to knock down lift-drag ratio and propulsive efficiency losses incurred at the engine inlet and exhaust exit.

As starting points for more detailed future design work, NACA displayed two aerodynamic shapes which might yield workable long range, 2,000 mph. transports. One model was essentially a flying wing with 80 deg. sweep at the leading edge to keep the entire wing within the wing-fuselage juncture shock wave. With this much sweep, chord-wise flow is subsonic over most or all of the wing. This permits use of a relatively thick wing with rounded edges while holding wave drag to a minimum.

The design is also intended to minimize drag due to lift. R. T. Jones of Ames reports that because of minimum drag due to lift at supersonic speeds, wing must be stretched in the streamwise direction as well as spanwise. He also reports that load distribution must be elliptical in all directions and not just on the spanwise axis as in the subsonic case. NACA has achieved the elliptical loading by use of a radical amount of twist in the wing.

In the second model, NACA sought to maximize lift-drag ratio by using a high-wing design with down-turned tips to create a favorable pressure field through mutual interference between the tips, and fuselage and the wing. Emphasis was on minimizing wave drag due to wing thickness and wave drag due to lift. The lift from the fuselage-created pressure field would have a distribution tending to minimize drag due to lift. Down-turned tips direct some of the air displaced by the fuselage downward.

New IAS Press Policy

Los Angeles—Institute of the Aeronautical Sciences will begin a new policy of information service to the technical and general press as a result of action taken by its council at the annual summer meeting here.

Adequate facilities for press coverage of IAS open meetings has been a growing issue since the joint IAS-Air Force Office of Scientific Research space symposium in Denver last spring and came close to an open break between the working press and IAS staff at the early technical sessions of the summer meeting here (AW July 14, p. 37). The issue was raised before the IAS council meeting and the following statement issued:

"At a regular meeting of the council of the Institute of The Aeronautical Sciences held in the Colonial Room of the Ambassador Hotel today (July 10), the question of improving information services to the technical and general press was discussed. In recognition of the need to keep the public informed of new developments in this age of rapid technological advance, the council instructed the staff to make a study of the requirements and approved a substantially augmented budget to provide more adequate assistance to the press at the Institute's national meeting."

The IAS council action received favorable comment in Los Angeles papers.

Stever Proposes ARDC Reorganization

By J. S. Butz, Jr.

Washington—Explicit changes in organization, management philosophy, financial procedures and personnel policies for Air Force research and development programs recommended by the ad hoc Stever committee would alter the command and mission of the Deputy Chief of Staff, Development, and the Air Research and Development Command.

Other changes proposed by the USAF Scientific Advisory Board committee (AW July 14, p. 29) would:

- **Largely answer industry pleas** for more realistic profit incentive on research and development contracts.
- **Stop the present rotation system** of project officers that places new and unfamiliar personnel in vital research positions at regular time intervals, often at the cost of progress.

The committee, under the chairmanship of H. Guyford Stever of the Massachusetts Institute of Technology, made its detailed recommendations after concluding a survey of the Air Force research and development program at the request of Chief of Staff Gen. Thomas D. White.

Lack of Authority

The committee said responsibility but no authority had been delegated to the working level of the research and development commands.

Authority was found to be concentrated in a few high offices in the Air Force and above.

The detailed supervision attempted by these offices, the committee said, slows progress and raises costs, defeating the ostensible purpose of the concentration of authority—lowering of defense costs.

The Stever committee said the relationship between the Deputy Chief of Staff, Development, and his operating agency, the Air Research and Development Command, is hampered by a large number of unnecessary controls that have been slowly accumulating since the organizations were created.

Its report noted "that there appears to be too much detailed direction of ARDC projects from within Deputy Chief of Staff, Development. Many of the DCS/D personnel have served in operating echelons of ARDC and tend to continue detailed project direction when assigned at higher headquarters."

The committee recommended that "DCS/D should direct and guide ARDC by promulgating clear policies and requirements, but should avoid detailed project direction. It is recognized that some involvement of DCS/D in detailed project management is inescapable, as long as Department of Defense and other higher echelons of government attempt, from time to time, to give detailed directions."

Primary Functions

The committee said its survey convinced it that Deputy Chief of Staff, Development, should be responsible for five primary functions: generating research and development requirements, formulating R&D policies, obtaining the resources for conducting the programs, integrating these programs into the total Air Force and governmental programs and evaluating and analyzing progress in order to facilitate decisions of the Air Council, Weapons Board and other headquarters organizations. It added:

". . . The first of these, the generation of R&D requirements, presently is participated in by both the Directorate of Requirements and the Directorate of Planning. These organizations must hear and weigh the opinions of military planners, scientists and engineers from both within and outside the Air Force. . . . Because these two directorates have similar objectives and activities, we recommend that they be combined."

Regarding the internally controversial questions as to who should establish specifications for future air weapon systems and generate the operational requirements, the Stever group said:

"The committee is informed that consideration is being given to removing the requirements (generating) function from DCS/D and placing it in Deputy Chief of Staff, Operations. The committee strongly believes that this would not be desirable, since it is convinced that the continuous development of the optimum in advanced requirements must be based primarily upon considerations of technical feasibility. Clearly, operations personnel must have an important voice in the establishment of forward requirements, but leadership in this function should be the responsibility of the R&D organization.

"The Air Force can only have the most advanced weapon systems by making maximum use of the state-of-the-art developments taking place in industry, scientific institutions and its own laboratories. It requires technically trained people from the R&D structure to evaluate these developments and to know what is feasible."

The committee also found that there was no group within the Office of the Deputy Chief of Staff, Development, with the specific responsibility for establishing research and development policies and said "a separate office within DCS/D should be responsible for it." The new office would set all policies for research work performed by Air Force installations and outside of the service by industry, educational institutions, etc.

Regarding the third and fourth functions of Deputy Chief of Staff, Development, the committee said:

"At present . . . those (functions) of securing resources for the R&D program and of integrating the R&D program into over-all Air Force activities are carried out by the Directorate of R&D and the Assistant for Development Programming. In this area, greatly increased emphasis must be placed on providing fully integrated sources for all major R&D programs.

"The necessity for an adequate evaluation organization within the Air Staff is recognized. The committee recommends the establishment of a separate office with DCS/D responsible for continuous evaluation and analysis of all present and planned weapon systems. This organization can provide the Air Staff authorities in the Weapons Board and Air Council with continuous and competent evaluation to help in their day-to-day deliberations and decisions."

ARDC Reorganization

Primary deficiency of Air Research and Development Command's organization, the committee said, is that it follows geographical lines rather than functional duties. To remedy this situation, it proposed that ARDC be organized with deputy commanders placed in charge of all distinct functional areas of the R&D program, these areas to be research, technical development, weapon systems and testing."

These deputy commanders, it added, should be responsible for over-all program guidance and direction and have authority over personnel, finances and facilities that are required for the execution of the programs.

Headquarters ARDC received a number of suggestions from the committee that closely paralleled those made for the Deputy Chief of Staff, Development. ARDC headquarters was found by the committee to be overstaffed and to exercise overcontrol of the research and development work carried on by its operating centers. Detailed committee recommendations for Headquarters ARDC included:

- **"Delegation of maximum authority** to the functional deputy commanders."
- **Concentrate the headquarters efforts** toward providing general directive guidance and resources adequate for the pro-

This commander, it said, should control all centers and laboratories that are primarily engaged in technical development. It said these centers should be considered for inclusion in this category—Wright Air Development Center, Rome Air Development Center, possibly the Special Weapons Center and probably Arnold Engineering Development Center. It added:

"The organization of the DC/TD (Deputy Commander, Technical Development), although it must provide support for weapon system programs, has as its major responsibility state-of-the-art development. To fulfill this responsibility, ARDC must initiate policies that will permit DC/TD to conduct substantial programs that are not restricted by normal military and production specification requirements. . . . These programs need not be directed toward specific weapon system requirements but should explore the possibilities of new approaches to component and equipment developments and occasionally to the design of major sub-systems. If the usual restrictive requirements are thus relaxed, it is almost certain that the time and cost for such developments will be substantially reduced, thereby making possible more rapid progress in many technical areas.

"The committee . . . (believes) that the present technical development program is less effective because it is encumbered by excessive staff activities at all levels and is seriously afflicted by 'empire building' at the centers. It is hoped that progress can be made in correcting these deficiencies by placing the entire program more completely in the hands of the DC/TD."

The committee also proposes that a Deputy Commander, Testing, be made responsible for the operation of the "Flight Test Center, Missile Development Center, Air Proving Ground Center, Missile Test Center and possibly the Special Weapons Center. The DC/T should be responsible for providing facilities and services but developmental testing should be under the other deputy commanders."

Reduced Staff

The reorganization of ARDC recommended by the committee would lessen the authority and responsibility of the center commanders and reduce the size of their staffs. The committee comments on this reduction in authority as follows, "This seems to be essential to more effective performance of the research and development mission."

The committee took a serious view of the over-all personnel situation of the Air Force and said the Air Force "must face the problems inherent . . . (in) dividing its efforts among the continuing need for manned aircraft, the growing needs for missiles and the emerging . . . needs for space technology . . . without having the strength in depth of scientific and technical personnel that is required to discharge its responsibilities.

"Over the past eight years, the increase in the technical education . . . of company grade Air Force officers has been somewhat impressive but still inadequate. In the field and general officer grades, only about one-third have technical degrees, rather less than in the sister services, and the percentage has been sliding slowly downward over the past eight years. The Air Force must come to understand that its ability to do its job depends to an ever greater degree on having a far greater proportion of its personnel trained in science and technology; otherwise, it will fail to carry out its expanding R&D responsibilities and eventually to operate effectively its increasingly complex weapons."

ARDC Views Stever Report

Washington—Stever Committee report on Air Force research and development needs is being reviewed by top level groups under USAF's Deputy Chief of Staff, Development, and the Air Research and Development Command. Coordinated view of the action Air Force should take on the Stever recommendations will be worked out between the two offices in joint meetings scheduled to begin within two weeks.

This coordinated view will then be presented to Gen. Thomas White, USAF chief of staff and the Air Council for further discussion and final approval of official Air Force policy for future research and development activity.

One of the main points made by the Stever report is that any real improvement in the research and development effort in this country will require a substantial policy change at levels above the Air Force as well as those within USAF. Stever committee recommends a renewed effort by Air Force leaders to convince Congress, Department of Defense and the Office of the President that the most efficient, rapid and economical research and development work can be accomplished only if longer term funding is provided and if the present tight controls exercised by the higher commands are loosened and more authority is delegated to the operating groups.

Degree of agreement by top Air Force officials with the Stever admonishment to press for significant policy changes probably will not be apparent for some time. However, reaction to the recommendations for internal changes within the Air Research and Development Command is becoming clear.

Lt. Gen. Samuel Anderson, ARDC commander and one of those instrumental in having the Stever Committee survey made, is pleased with their report. He feels that most of the suggestions are in the right direction toward solving present and future problems but probably will have to be altered before being put into effect. Some of his specific points:

- **ARDC has been using every means at its command for the past year to provide long term funding for research projects, especially contracts with universities.**
- **Putting centers under deputy commanders would be easy with test centers but, with installations such as Wright Air Development Center, it would be difficult.**
- **Suggestion for making ARDC a procuring agency along with Air Materiel Command could create many new headaches within ARDC even though it would undoubtedly accelerate some work. Gen. Anderson feels that ARDC's present relationship with AMC is an excellent one.**
- **Cutting across lines of command and giving project commanders packaged resources, personnel, facilities and funding, as was done with Ballistic Missile Division and is being done by Advanced Research Projects Agency, is a good policy.**

ARDC's study of the Stever Report is being conducted by two separate groups. One is the ARDC Council composed primarily of men at the deputy commander level who have a considerable stake in any reorganization. The second is an ad hoc committee of men from the command but whose identity has not been made known outside Anderson's office. The reports of these two groups will be considered along with the views of the center commanders in preparing ARDC's official review of the Stever Committee recommendations.

AMB Asks For Bids On Landing System

Washington—Airways Modernization Board is seeking possible new techniques that will permit automatic or semi-automatic landings under instrument weather conditions.

Representatives of 20 avionics manufacturers last week heard AMB representatives outline requirements for an Experimental Elevation-Position Determining System for Landing. Purpose of upcoming AMB procurement is to seek out and evaluate new approaches to the instrument landing problem other than techniques that already have been developed. Latter includes airborne flareout adaptors, such as those developed by Hazeltine, Minneapolis-Honeywell, North American and Raytheon, and the ground-based AN/GSN-5 system developed by Bell.

Bristol Type 192 Helicopter Makes First Flight

Twin-turbine powered Bristol Type 192, one of Europe's largest military helicopters, makes first flight at Bristol Aircraft, Ltd.'s Weston Division plant. Type 192 has been ordered for Royal Air Force for troop and freight transport, aerial ambulance duties and search and rescue operations. Aircraft is powered by two Napier Gazelle Series 2 engines, each developing 1,650 eshp. Rotors are 48 ft. 8 in. long. Type 192 can carry 18-25 soldiers, or 6,000 lb. freight.

grams in progress under the deputy commanders.

- "**Emphasis upon the continuous** appraisal of all major projects and programs to insure that they are consistent with the objectives of the Air Force.
- "**Emphasis upon the continuous** assessment of technical progress and management effectiveness.
- "**The avoidance of short-term** project guidance or control."

The Stever committee's detailed suggestions extended to the management of the four functional areas of the ARDC program which they said should each have a deputy commander in charge. These are research, technical development, testing and weapon systems.

Research 'Scattered'

The report said "the research program of the Air Force is widely scattered through various centers and other offices and is badly compromised by confusion as to the purpose of this research program and its over-all direction, research is interwoven with technical development and even weapon systems projects, usually to the detriment of the research program.

"In order to provide a sound basis for improving this situation with respect to research, the committee recommends the establishment of a Deputy Commander for Research (DC/R), (who) . . . would be (responsible) for the entire exploratory research program of the Air Force. It is desirable that this responsibility be separated and placed under a deputy commander in order to insure that exploratory research is given adequate attention and is not neglected in favor of the much larger technical development program. . . .

"The DC/R should . . . also serve as the commander of the Office of Scientific Research and . . . should have under his jurisdiction . . . such in-house laboratories of the ARDC as are presently engaged primarily in exploratory research. Believed to be in this category are the Aeronautical Research Laboratory of Wright Air Development Center, the Geophysics and Electronics Research Directorates of the Cambridge Research Center, the Aeromedical Field Laboratory of the Missile Development Center, the Brussels Office of ARDC and the nonclinical research laboratories of the School of Aviation Medicine."

"Under DC/R there should be separate divisions for physical and life sciences . . . to insure that life sciences (medical science, biology, psychology and social sciences) are given proper recognition and emphasis in the total Air Force program of exploratory research.

"The organization of exploratory research operations within the Air Force should not be required to fit a normal military command formula. It would be feasible, for example, that the DC/R himself be an eminent (civilian) scientist."

The committee also found numerous faults with current Air Force technical development efforts, saying "the greatly increased emphasis which has been placed during recent years upon . . . weapon systems project management . . . has tended to ignore the technical competence which is available within the Air Force.

"As a consequence, competence is decaying and morale is sinking in many important areas of the Air Force technical development effort. In addition, technical development directed toward the support of specific weapon systems is increasing at the expense of the state-of-the-art development.

Competence Levels

The report points out that ARDC has considerable competence for technical development and for monitoring work being contracted to various outside groups.

Concerning ARDC's capabilities compared to those of outside sources, the report says that, "with few exceptions, . . . the levels of competence in technical development are somewhat higher outside than within the Air Force. Nevertheless, the Air Force must maintain some in-house capability in technical development because at times it might be either impossible or impractical to have certain highly specialized types of development performed under contract."

The group recommended, that the entire Air Force program in technical development, "wherever located and whether conducted in-house or by contract," be placed under the direct supervision of a Deputy Commander in ARDC for Technical Development.

Airline Space Inventory Asked in Crisis

Washington—Defense Department last week called upon U.S. airlines for a complete inventory of passenger and cargo space available on overseas flights immediately after President Eisenhower's decision to send Marines into Lebanon.

The action focused attention on the fact that the standby contract covering the much touted civil reserve air fleet (CRAF) still remains unsigned after a three-year stalemate. It also indicated that Military Air Transport Service (MATS) was preparing to divert routine transocean operations to logistical support of military activities in the Middle East, although this would not be confirmed by the Defense Department.

In telegrams sent to scheduled airlines operating overseas routes and to the Independent Airlines Assn., Capt. William P. Quinn, Scott AFB, Ill., asked the carriers to detail their capability to handle traffic to all MATS overseas bases between July 16 and Aug. 15. Capability available was to be submitted in "five day increments" and both pressurized and non-pressurized aircraft were designated as acceptable.

A Pentagon spokesman linked the telegram directly to the Middle East crisis and admitted that MATS, as a result of the Iraqi revolution, is "exploring" industry airlift capacity. As of late last week, however, the Defense Air Transportation Administration had received no orders from the Office of Defense Mobilization to call upon CRAF for military duty.

CRAF Fleet

The CRAF fleet now consists of 309 four-engine aircraft compared to a MATS fleet of 375 aircraft excluding the special mission fleet. In the event carriers are called upon to turn their reserve fleets over to the Defense Department, they would do so without any contract with the U.S. government.

However, Air Transport Assn. President Stuart Tipton last week told a House Appropriations Subcommittee that, although the Air Force has not acted on the stand-by contract, the airlines have activated CRAF without formal approval of an agreement.

One phase of the stand-by contract has been signed by all but one airline. This agreement involves the organization of industry groups to be called operations boards which provide advisory services to MATS in preparing for the operation of CRAF. The boards also provide the means through which MATS will operate CRAF once the airlift begins.

Last week, an undisclosed number of Douglas C-124 Globemasters were flown from Donaldson AFB in South Carolina to augment the C-124 fleet assigned to European bases last spring during the early stages of the Lebanese revolt. MATS now has a total of 242 Globemasters under its command.

Observers here think that the Globemasters in Europe plus MATS' fleet of C-119s and C-130s will be restricted to airlift activities serving the troubled area. Gap created on regular MATS routes by this action will be filled with available space on scheduled and supplemental airline services.

CRAF cannot be called into operation if the additional airlift provided by the carriers is insufficient to handle military traffic unless there is an executive order signed by the President declaring a national emergency. And, in such an event, the military must take the entire fleet of 309 airplanes since partial mobilization has been ruled out in the basic arrangement between the carriers and the Defense Department.

Sen. Stuart Symington (D.-Mo.) said last week that he did not feel the military airlift was adequate to support troop action in time of emergency.

Independent Airlines Assn. has 38 planes available for military support, 90% of which are four-engine equipment.

Meanwhile, most of the Mid East was cut off from commercial air transportation although both Trans World Airlines and Pan American World Airways were maintaining regular frequencies in east-west schedules by bypassing Lebanon and Iraq during the initial phase of the flare-up.

Pan American suspended service into Beirut and Damascus for 24 hours but resumed operations into Beirut following occupation of the Beirut airport by the U. S. Marines on Wednesday. Service to Damascus was restored later but scheduled service to Baghdad was being terminated in Ankara.

The airline planned to maintain its schedule of eight flights weekly through the area by rerouting trips through Teheran and Istanbul whenever necessary for the safety of its flights.

Iranian civil aviation authorities say that a radio message from Iraq advised that civil aircraft operating between Teheran and Europe will be permitted to fly over Iraqi territory but would not be allowed to land. Pan American chose to dispatch its flights over routes avoiding Iraq but KLM operated a trip over the Iraqi territory without incident following the announcement.

TWA Delayed

A Trans World Airlines 1049G Constellation Manila-New York flight, which was denied takeoff privileges at Basra airport following the outbreak of the Iraqi rebellion, was delayed 15 hours before receiving permission to continue its eastbound trip. The flight carrying 25 passengers and a crew of 10, had landed at Iraq for a 45-minute stopover.

Immediately after the incident, TWA revised scheduled routings to bypass Basra by operating flights through Cairo directly to Dharan.

British European Airways last week cancelled all flights east of Nicosia with the exception of those scheduled for Tel Aviv. Cyprus Airways cancelled all its eastern flights.

Last week, the State Department instructed its passport office to advise American tourists against travel in the Middle East, particularly in Lebanon and Iraq.

Military Air Support

Washington—Navy carrier aircraft and Air Force troop carrier transports supported the landing of U. S. armed forces in Lebanon last week.

Aircraft from the carrier USS Essex supporting the initial landing of one batallion of Marines included the McDonnell F2H-4, North American FJ-3, Douglas A4D and various Douglas AD models.

Later in the week, heavy troop carrier aircraft of an undisclosed type and unit, probably the Douglas C-124, were used to transport 1,600 men of the 1st Airborne Battle Group of the 187th Infantry from their post in Germany to an unspecified destination. These paratroopers and their normal complement of equipment had been placed under the command of Adm. James L. Holloway, commander of the U. S. forces around Lebanon.

As the first landings to secure the airfield south of Beirut were being made, the first elements of a USAF Composite Air Strike Force from the Tactical Air Command were deployed overseas from bases in the Eastern U. S. Less than 24 hours later, the first aircraft of this strike force had arrived at their destinations and were dispersed.

Other air strength in the Mediterranean area included units aboard the carriers USS Saratoga and USS Wasp of the U. S. Sixth Fleet. The Saratoga is equipped with Chance Vought F8U, Grumman F11F and F9F-8 and Douglas A3D, AD and A4D aircraft. The Wasp is basically an antisubmarine carrier carrying Grumman S2F, Douglas AD and Sikorsky HSS-1 aircraft. Naval surface strength around Beirut includes the missile cruiser USS Boston.

Horner, Norton Confirm Crimp In Research and Development

By Katherine Johnsen

Washington—Continued existence of fiscal ceilings and delaying procedures which are hampering military research and development programs (AW April 21, p. 26) were officially confirmed last week by Garrison Norton, Navy Assistant Secretary for Air, and Richard Horner, Air Force Assistant Secretary for Research and Development. After the appearance of the Soviet earth satellites, the President had assured that dollars would no longer dictate defense.

In an appearance before the House Government Operations Committee, Horner protested that "the individual at the financial end is not qualified to make decisions on research and development programs."

In line with the recommendations of the ad hoc Stever Committee of the USAF Scientific Advisory Board (AW July 14, p. 29), Horner called for decentralization of authority and responsibility over programs, noting "the inability of any individual except those in close proximity to judge" a complex research and development project. "It is virtually impossible to manage by remote control", he declared.

The establishment of Advanced Research Projects Agency and the establishment of a Director of Research and Engineering in the office of the Secretary of Defense provided in pending legislation for reorganizing the Defense Department, Horner cautioned, "provides the tools for further centralization of control". He suggested that their activities be confined to "coordination" to eliminate duplicatory work.

Committee Chairman Rep. William Dawson (D.-Ill.), announced that his group would carefully watch steps taken by the new Director of Research Engineering. Dawson said the director will have "great authority and wide latitude in reorganizing the structure and procedures through which the Department of Defense and its component departments conduct scientific research and development.

"Consequently, the lessons to be learned from experience and from the existing organization and operations should be very valuable to members of Congress who will be responsible for evaluating the results."

The two points emphasized by Norton were:

- **"Level dollar outlay"** for research and development has actually "settled into a policy" of the Defense Department.
- **Under this policy,** the "real" purchasing power for research and development is actually declining because of the inflationary trend. Added to this, Norton said, is the increasing cost for weapons and maintenance because of their complexity.

Three fiscal processes which keep the over-all research and development program in a "straight-jacket" and cause disruptions in projects were outlined by Norton and W. W. Edwards, comptroller of the Office of Naval Research. They are:

- **Apportionment plan** of the Budget Bureau. Funds appropriated by the Congress are not available for use until "apportioned" by Budget Bureau. This is usually not worked out until one or two months after the July 1, the start of the fiscal year. The apportionment for Fiscal 1959 has not yet been made. Meanwhile, Budget Bureau has given Navy authority to obligate one-twelfth of its Fiscal 1959 appropriation for research and development each month.

Edwards said that one major contract expiring Aug. 1 will require "much greater than the one-twelfth" to keep going. He said there are numerous other contracts in the same position.

- **Financial plan of Department** of Defense. Although expenditures for research and development under law are on a "no year" basis. Edwards said this plan, for practical purposes, puts them back on a year-to-year basis. Each year, the expenditures for each research and development project must be fitted into the plan. If funds earmarked for a project are not actually expended in a fiscal year, he explained, they are "lost." The expenditure must be fitted into the plan for the new fiscal year.
- **Expenditure target.** This, stemming from the financial plan, amounts to a ceiling on expenditures and confronts Navy with the problem of cutbacks.

In Fiscal 1958, Naval research and development was put under a legal expenditure "limitation." The "target" is a somewhat milder directive.

USAF Small Business Survey

Washington—Air Force is conducting a survey to evaluate effectiveness of its policies and procedures to facilitate small business participation in its procurement.

Survey, which began July 7 and will extend to Aug. 6, includes a study of the activities of small business specialists, emphasizing distressed labor areas and "set-asides," as well as cost of implementing the procurement program. Set-asides are potential contracts that can be set aside by the small business specialist for exclusive bidding by small business firms in that area.

A team of three officers and a civilian is covering these installations:

Sacramento Air Materiel Area, McClellan AFB; San Francisco Air Procurement District; Air Force Special Weapons Center, Kirtland AFB, N. M.; San Antonio AMA, Kelly AFB, Tex.; Denver Air Procurement Office; Wichita Air Procurement Office, Wichita, Kan.; Mobile AMA, Brookley AFB, Ala.; Air Force plant representative, Boeing Airplane Co., Wichita; AFPR, Beech Aircraft Corp., Wichita; USAF headquarters, Washington (July 21-22); Atlanta APD (July 22); AFPR, Ford Motor Co., Chicago (July 23); ARDC headquarters, Andrews AFB, Md. (July 23); Detroit APD (July 24-25); Philadelphia APD (July 24-25); Rome Air Force Depot, Griffis AFB, N. Y. (July 28-29); AFPR, General Electric Co., Syracuse, N. Y. (July 29); New York APD (July 28-29); Boston APD (July 24-25); Dayton APD, Wright-Patterson AFB (July 28); Dayton AFD, Gentile Air Force Station, Ohio (July 29); AMC headquarters, Wright-Patterson AFB (July 30-Aug. 1); Air Force Ballistic Missile Office, Inglewood, Calif. (Aug. 5-6); Los Angeles APD (Aug. 5-6); San Diego APD (Aug. 5-6); AFPR, Convair Division of General Dynamics Corp., San Diego (Aug. 5-6).

Missile Systems Unit Formed by Allison

Indianapolis—Allison Division of General Motors Corp. has reorganized its Aircraft Engineering Department to form a new Missiles System Department and expand its Research Department. The Army and the Air Force also have awarded Allison a development contract for a 250 horsepower turbine engine for light planes and helicopters that weighs only 90 lb. and promises a substantial performance boost for the designers of light aircraft.

Turboprop version of the new engine which weighs only 109 lb. will enable twin-engine lightplanes to fly more than 300 mph. above 15,000 ft.

Dimitrius Gerdan, director of engineering, Aircraft Engines Operations, is in charge of the entire engineering operation at Allison. The new Missile Systems Department will be under John R. Gretzinger. Allison created the department to put itself into a better position to bid on manned aircraft, missile and rocket propulsion systems work.

Airlines Take Sides in No-Show Dispute

American leads opposition to present regulation; final decision scheduled to be made in November.

By Robert H. Cook

Washington—Air Traffic Conference members will make a last ditch stand at their November meeting to retain the present no-show plan which is under attack by American Airlines as too costly and "second best."

The originator of the three phase plan, American now plans to adopt a new verification system and last week released results of a survey by the Opinion Research Corp. indicating public dissatisfaction with the current plan. Survey findings were compiled from answers to 31 questions submitted to 444 passengers.

First indication of American's intentions came at the April meeting of the ATC when the carrier announced its proposed verification plan (AW April 21, p. 25). It did not press for action, however, until the conference met again the following month. Faced with the possibility of complete and immediate abandonment of the no-show plan, if American chose to force the issue, objecting carriers agreed to a compromise providing discontinuance of the $3 no-show penalty by Aug. 12 and extension of the minimum time limit and reconfirmation rules to Dec. 1 (AW May 26, p. 39).

Minority support to drop the plan in its entirety came from Mohawk which contended it was too expensive and inconvenient to both passengers and the airline. Along with Allegheny, which competes with the carrier on the Detroit-Erie route, Mohawk elected to abandon the system on Aug. 12.

Meanwhile, the Civil Aeronautics Board is completing a study on the no-show problem and must approve or disapprove the conference-voted termination dates. Majority supporters of the three-phase plan are reluctant to part with what they consider a winning combination—no-shows have decreased an average of 61% since the first minimum time limit rule for ticket pickup went into effect Sept. 1, 1956, according to a survey by the Air Transport Assn.

Most of the plan's supporters agree that the penalty phase has been costly to administer and already has served the useful purpose of a "psychological club" to deter no-shows.

Major concern of these carriers is that American's stand will force a conference vote that may result in a possible combination of parts of the verification system and the present no-show plan, which might cause loss of ground already gained. American also could elect to "go it alone" and possibly force other carriers to adopt verification as a competitive measure, although this possibility is unlikely. Of equal concern is a possible CAB action to implement a plan more restrictive than either of the former.

American contends that its suggested plan will "shift the responsibility for good reservations and ticketing practices from the customer to the airline." Its plan eliminates the penalty clause; holds the airline responsible for double checking reservations and modifies the ticket pickup time limits, primarily to accommodate persons living in outlying areas or those who might be asked to purchase tickets at inconvenient hours.

The airline also has emphasized that verification will be used only on flights that are customarily booked heavily. American feels this "selectivity" will allow a more economical administration of the plan than the current no-show plan applied on a system-wide basis.

The carriers says the results of the Opinion Research Corp. survey are "revealing" in respect to the number of passengers inconvenienced by the present system and their "apparent willingness . . . to help us find solutions to the no-show problem." In a two week period, surveyors questioned passengers at New York, Chicago, Los Angeles and Washington, D. C.

While 78% of a group of 444 passengers interviewed were aware of airline rules for reconfirmation and ticket pickup, only 23% knew that changes in procedure were being considered. Asked for details of the last time either phase had caused them inconvenience, only 16%, 71 passengers, replied in detail, with 5% claiming they had too far to travel for ticket pickup and an equal percentage forgetting to reconfirm. A total of 5% had been assessed the $3 penalty and were evenly split on the justice of the rule. The survey reported 20% favored ending no-show rules.

Civil Aeronautics Board complaint records showed a significant number of complaints concerning the plan when it was first implemented, but spokesmen say they are now "almost non-existent." Carriers favoring retention of the plan claim they have received very few complaints, most of them resulting from procedural breakdowns rather than policy.

In their own surveys, most agree the penalty phase is costly to administer with Capital Airlines estimating that it recovers only 25% of the cost of imposing the $3 fine.

Eastern and National Airlines, both of which enforced a reconfirmation rule for several years on their Florida routes prior to adoption of the full no-show plan, are among the most powerful proponents for retention of the present plan. Together with Northeast Airlines, they have indicated they will retain the plan on their New York-Florida routes regardless of the outcome of the next Air Traffic Conference meeting.

On the basis of experience, Eastern favors minimum time limit and reconfirmation. The carrier says these measures are in the interest of passengers as well as an airline, pointing out that when reconfirmation was rescinded by the industry in 1955 Eastern was flooded with complaints. Reinstated on certain cities on its routes, the rule resulted in a definite drop on no-shows as compared to cities not covered by this rule, the airline said. The airline added that the to-be-abandoned penalty phase accounted for nearly 50% of the cost of the entire program.

Eastern says it is opposed to the verification plan because:

- **Verification is a duplication** of existing procedures. Present procedures include firming, reconfirmation and the sending of itinerary advice messages. Eastern contends that these procedures more effectively meet the proposed purpose of verification at a much lower cost.
- **Verification allows errors to** "snowball," particularly in the case of errors made by a delivering carrier.
- **On multi-legged itineraries,** errors are not discovered until too late to correct the situation.
- **In the months verification was tried,** Eastern contends that there was no appreciable reduction in the volume of no-shows.

Eastern says a primary advantage of the present plan is that it makes cancelled space available in sufficient time to resell it. ATA figures show that 30% of all late cancellations were resold by the airlines in April.

National Airlines' stand is similar to that of Eastern in that the carrier feels the entire plan now being used should remain untouched.

Northeast Buys Capital's Viscounts

Northeast Airlines last week purchased nine turboprop Vickers Viscount 745Ds, part of Capital Airlines' "deferred" order of 15. The order, plus spare Rolls-Royce Dart engines, spare parts and an option on a tenth aircraft, will represent an investment of approximately $15 million.

To finance the aircraft, Northeast entered into an Equipment Trust Agreement with both Vickers-Armstrong Ltd. and Rolls-Royce Ltd. The Irving Trust Co. of New York will serve as trustee. An Equipment Trust Agreement is a provision of a recent amendment to the Bankruptcy Act that allows a bank or manufacturer who finances the purchase of aircraft to reclaim them before other provisions of the act become effective.

Present plans of Northeast call for putting the Viscounts into service next month on East Coast routes serving Boston, New York, Philadelphia, Washington and Montreal. Service will be extended to Portland, Maine, and south to Jacksonville, Tampa and Miami, Fla., in the fall. For several weeks Northeast personnel has been training with Capital Airlines in anticipation of the Viscount purchase.

Northeast will continue to operate its Douglas DC-6Bs on its high density Florida route until financial conditions warrant purchase of turbojet equipment. The carrier did not pick up its option for 5 Bristol Britannias. Airline hopes that by flying Viscounts in high traffic areas that it will get better passenger identity and will also be able to act as its own feeder to its Florida route.

Vortac Backed as Navigation Aid

Washington—Airlines have taken an official position in favor of the distance measuring equipment portion of Vortac (DME-T) as an international navigation aid on a permissive basis where traffic densities require it.

Air Transport Assn. also has taken a stand on the controversial subject of possible Vortac user charges which the government might assess against the airlines, either directly or in the form of gasoline taxes, for their share of the cost of installing and operating an extensive Tacan network in the U.S.

Original civil DME would have been perfectly adequate for airline needs, and the ground station cost would have been only about one-sixth as much as Tacan stations which are now going in because the military insisted it needed Tacan. ATA contends that the airlines should not be penalized in any possible user charges because of military requirement for Tacan. Instead, ATA asks that any civil user charge be based on what rho-theta system costs would have been if original civil DME had been used as originally planned.

Domestic Use

Airline Operations Conference, after studying the traffic control requirements set forth by Air Coordinating Committee, agrees that some type of distance measuring capability will be required to meet ACC's route width and facility spacing criteria. However, this capability could be provided by other means, such as Doppler autonavigators, as well as by DME-T.

ATA points out that many airlines believe that DME-T will be desirable and that a few believe it will be required for efficient and economic operations. One airline, American, has placed orders for DME-T for its new jet and turboprop transports. Another, believed to be United, has indicated its intention to install DME-T in its entire fleet.

Any airline industry decision as to whether to implement DME-T on a fleet-wide basis will await service tests by a few carriers to evaluate the operational utility of DME-T and to establish practical operating accuracy of equipment for traffic control use.

ICAO Proposal

The airline statement backs State Department plans to propose that DME-T be substituted for original civil DME in International Civil Aviation Organization's Annex 10 at ICAO's meeting in Montreal next February. The meeting was called to consider short-range navigation aids.

ATA recognizes that DME-T will face opposition at Montreal, particularly from Britain, and that the future of VOR as an international navigation aid also is up for review. ATA says, however, that, regardless of ICAO's decision on DME-T, "the airlines feel that the VOR system requires primary protection, encouragement and expansion."

Regardless of the merits of other position fixing systems, ATA says, widespread and world-wide implementation of both ground and airborne VOR equipments, both in air carriers and general aviation, makes continued use and expansion of VOR "of vital importance to the airlines."

ATA also opposes inclusion of more than one short-distance navigation aid for international adoption because of the economic penalty of equipping aircraft with additional equipments.

News Digest

Jefferson County, a suburb of Denver, is latest governmental subdivision to enter tax lists against companies doing defense work on government property (AW July 15, 1957, p. 30). County wants $2,000,000 annually in taxes levied against the Martin Co., which is building the Titan intercontinental ballistic missile; Air Products, Inc., and Dow Chemical Co. Court action in the matter appears likely; county assessor has placed total assessment value of the three companies at $42,384,640.

American Airlines earned $5,606,000 net during the first six months of 1958, exclusive of $1,596,000 in net profit after taxes from disposal of property. The $7,202,000 total net earnings compare with $6,814,000 during the same 1957 period, which included $1,137,000 from property disposal. Airline carried 3,877,000 passengers during the 1958 period for a total of 2,456,044,000 passenger-miles, off 3.3% from 1957 first-half passenger-mile total.

Dr. Edward P. Warner, 63, retired president of the International Civil Aviation Organization, died July 12 at his home at Duxbury, Mass. Dr. Warner was editor of *Aviation* magazine, one of the magazines that combined to form AVIATION WEEK, for five years.

USAF confirmed a letter contract for $314,800,000 to Convair Division of General Dynamics Corp. covering past and present research and development of Atlas ICBM and related support equipment.

Vertol Model 76 tilt-wing experimental VTOL aircraft, made its first flight transition last week. From a low altitude hover at Philadelphia International Airport, the Vertol 76 converted quickly to level flight and flew across a runway.

Everett B. Schaefer, chief engineer of Canadair Ltd. Aircraft Division, died July 9 at Montreal after three-months of illness.

Pan American World Airways has signed contracts with Boeing Airplane Co. and Douglas Aircraft Co. to provide a fifth pod on its 707 and DC-8 jet transports. Pod will be mounted on the left wing between inboard engine and fuselage and will be used to carry spare engines to disabled aircraft (AW April 7, p. 42).

Senate Approves Federal Aviation Bill

By L. L. Doty

Washington—Legislation proposing creation of an independent Federal Aviation Agency was passed by the Senate last week, but House action was threatened with delay by the prolonged investigation of Boston textile manufacturer Bernard Goldfine.

As of late last week, hearings on the agency by the House Commerce Transportation Subcommittee were still temporarily shelved and apparently second-in-line to the probe of Goldfine and presidential aide Sherman Adams by the Special House Committee on Legislative Oversight.

Since five congressmen are members of both committees and Rep. Oren Harris (D.-Ark.) is chairman of both, as well as chairman of the House Commerce Committee which will report on the FAA bill, both investigations cannot be conducted simultaneously. The federal aviation bill probably will have to take a back seat until the spectacular Goldfine case is either concluded or recessed.

The House Transportation Subcommittee still wants to hear several witnesses, including D. W. Rentzel, Slick Airways head, before it goes into executive session to consider the bill. As a result, it will be several weeks, at best, before the bill hits the House floor for a vote.

Final Outlook Good

There is only a slight chance that the delay will prevent Congress from enacting the aviation measure before the current session ends.

The House Commerce Subcommittee undoubtedly will act quickly on the bill as the date of adjournment draws closer because of a popular demand for its passage and the ease with which it met Senate approval.

The bill was offered in the Senate by Sen. A. S. Mike Monroney (D.-Okla.) who originated, sponsored and guided the legislation through to a floor vote in its favor.

Only obstacle the bill faced in the final moments of its passage was an amendment proposed by Sen. Andrew Schoeppel (R.-Kans.) on the selection of missile bases.

A compromise provision was reached on the amendment that drew Monroney's support, and the bill was passed by voice vote without further objection.

Under the original amendment, the Defense Department was given the right to select the military airports and missile launching sites without conferring with the administrator of the Federal Aviation Agency.

Monroney bitterly opposed the amendment because he said it could place the Federal Aviation Agency in a "position of a subsidiary of the Pentagon instead of a civilian agency."

He told the Senate that his "quarrel" with the military was based on its desire to have full participation in the agency—"even to the extent of having a military man in uniform as Deputy Administrator"—and at the same time to deny the agency any authority to decide against "an unwise location of a missile site or military airport." He added: "It looked to me as though the military wanted to have it both ways."

DOD Position

Schoeppel admitted to the Senate that the amendment was drafted "by reason of testimony of and the position taken by the Department of Defense, particularly by the Assistant Secretary of Defense." He added:

"I know the military has been arbitrary in some respects but when the chips are really down, we must depend on the military for our defense requirements, and for the location of defense projects which are needed."

Under the revised amendment approved by Monroney, the FAA administrator must be informed of the establishment and construction of any airport or missile site so that he may advise appropriate congressional committees of the effects of such action. In the case of a deadlock between the Defense Department and the administrator, the matter will be appealed to the President for a final decision.

In presenting the bill, Monroney said failure of Congress to act on the agency this session would cost human lives. He charged that "years of subordination and neglect of civil aviation" has caused an inadequate common system for the control of traffic.

Chain of Command

He said that the bill would take the air traffic control agency "out of the basement of the Department of Commerce" and thus remove "one layer of bureaucracy, which has not been particularly interested in aviation until recently." Passage of the bill, he added, will enable the agency to report directly to Congress and the President and permit it to present its needs for operating funds directly to the Bureau of the Budget.

In response to a suggestion from the floor that airlines contribute toward the building of airports and the operation of airways facilities, Monroney pointed out that fuel taxes "substantially" reimburse the government for the cost of airports. He noted that half of the airport costs are borne by the local communities and that landing fees, service charges and rentals to the airline help absorb those costs.

In looking to the future of air traffic control, Monroney called for a "careful study" of air traffic control personnel and urged that the service be made more attractive to controllers who "are subjected to tremendously nerve-wracking conditions."

He added that studies are "required as to the physical fitness of such employes and as to the possibility of early retirement."

He also asked for better training programs and more rapid promotion for personnel. He told the Senate that there is a "vast need in the field of aviation medicine" and recommended that the administrator undertake a study of the subject as soon as the agency is established to meet the problems of jet transportation.

Boeing 707 Tested At Mexico Airport

Mexico City—Boeing 707 jet transport, bearing Pan American World Airways' markings, flew here nonstop from Seattle, Wash., in 4 hr. 10 min., to conduct landings and takeoffs under high altitude conditions. Airport is 7,300 ft. above sea level.

Aircraft flew at 26,000 ft. at an average speed of 575 mph. Top speed recorded was 670 mph. in the 2,330 mi. trip. A Civil Aeronautics Administration official was aboard for certification observations.

Major problem at Mexico City was locating about 500 gal. of distilled water for use in water injection, or "wet" takeoffs. Search of the city finally produced the water in 400 five-gallon jugs. Engineers also had to use the 707's power supply for ground starts, because Mexico City International Airport did not have a power unit.

Company officials said jet transport payloads from Mexico City would be reduced unless the existing runways are lengthened. Local airline officials said this probably would not be done unless Mexican airlines buy jets, noting that the improvement would only help their competition.

Engineers also found that 707s outboard jet pods extended past runway edge and raised a threat of foreign object damage.

Mexico City Airport recently was used for the altitude tests by the Lockheed Electra prototype (AW July 7, p. 41).

Idlewild Door Opens to 707 Trial; U.S.-British Rivalry Is Factor

By Glenn Garrison

New York—Boeing Airplane Company's 707 jet transport breached the noise barrier at New York International Airport last week as the Port of New York Authority granted permission for a 30-day New York-Puerto Rico restricted trial service.

The agency's approval of a Pan American World Airways request eased the threat that Port Authority resistance to the 707 might help put the British flag ahead of the U.S. in starting transatlantic jet service.

Port Authority had been delaying any official stand on the acceptability of the production 707 until full-load takeoff noise tests completed data the agency had accumulated at Seattle earlier this year. These full-load tests were finally scheduled last Friday at Seattle.

But rumors persisted in the industry that the Port Authority wasn't satisfied with the 707's noise level in the early tests. This view was recently reinforced by British Minister of Transport and Civil Aviation Harold Watkinson at a press conference here following consultations with the Port Authority.

Watkinson told reporters that indications from Port Authority data were that the aircraft was very noisy and would present problems at London Airport. He said London wouldn't accept the 707 if the Port Authority decided not to.

The British minister also said that the Comet IV would be flying the Atlantic for British Overseas Airways Corp. "just as soon" as the 707 went into transatlantic service. BOAC and Pan American are in an unannounced race to get the first jet schedules on the run.

Watkinson's remarks gave rise to speculation that Port Authority disapproval of the 707 would provide the British with a tool to delay the American carrier's jet operation, or through restricting the use of the plane to cut its operating performance to the level of the shorter-range Comet IV.

The British already have banned Russia's Tu-104 jet transport from London Airport, a decision which has brought complaints from British European Airways. BEA has been forced to hold up its proposed London-Moscow service reportedly as a result of the ban.

The Port Authority said it gave no material to Watkinson, only exchanged "preliminary observations" with him.

Pan American in a letter dated July 15, requested permission for the limited operation, and Port Authority Chairman Donal V. Lowe officially granted the request two days later. The action followed conferences last week between the carrier and the agency.

Under the agreement, the 707-120 with 21-tube noise suppressors is cleared to make trial runs between New York and Puerto Rico for a 30-day period beginning about Aug. 15. Maximum weight will be limited to 190,000 lb., the aircraft must have the necessary Civil Aeronautics Administration certificate, flights will be made during daylight hours, and the 707 must attain 1,500 ft. or more after takeoff before reaching communities adjacent to Idlewild.

Pan American will make one or two roundtrips daily between the two points and will carry cargo. Airline previously had asked CAA to approve a trial cargo service from Baltimore to San Juan. The request was turned down temporarily, but CAA last week okayed the similar operation from New York. No commercial passengers will be carried, but government observers and representatives of other airlines and the Port Authority have been invited to participate.

BOAC's Comet IV has not been fully cleared by the Port Authority, but has received permission to come in for demonstration flights and is expected to get an unlimited green light following the demonstrations.

Delay in receiving a final Port Authority decision on 707 operation has caused considerable uncertainty in the industry in recent weeks and the noise question has taken on some of the aspects of a high-stake poker game. Time is growing short, with Pan American hoping to start scheduled transatlantic service Nov. 1 and American Airlines planning New York-California nonstops before the year is out. These were other recent developments in the situation:

• **Boeing** said full-load noise tests of the 707 were unnecessary. The Port Authority could make its decision on the basis of data gathered during earlier Seattle tests without need for a full-load test, Boeing indicated. The manufacturer says it has met its contractual obligations to customers by developing and installing a suitable sound suppressor, but is naturally concerned over the problem and is trying to work out a joint program with the airlines to solve it.

• **Pan American** advertised first jet service this fall, daily to London and Paris. The ad spoke of "first and only jets on the Atlantic."

Watkinson indicated that Port Authority approval of the 707 would virtually assure London's approval, and Paris might be expected to follow suit. Meanwhile, Pan American has definite assurances that it could operate at several eastern U. S. airports other than Idlewild and at some European terminals.

BOAC's advertisements include reference to the Comet IV as slated for New York-London service soon. Asked for comment on Watkinson's doubts concerning the 707—of which BOAC has ordered 15 for 1960 delivery—BOAC said "the question of the acceptability of any jet aircraft at London Airport is the responsibility of the Minister of Transport and BOAC feels it would be improper to make any comment at this time."

American Airlines told AVIATION WEEK that a decision on the 707's acceptability at Idlewild is "very critical for us." The airline has been waiting to hear from the Port Authority on the test results, it said. Plans to build interim ready rooms at Idlewild for jet passengers have been held up by American, on instructions from the Port Authority, until the decision is announced. Construction of these facilities was expected to begin July 1. American said, however, that it is confident that the 707's noise suppressors "will meet any requirements of any airport we will be serving."

The British minister said London Airport wants to make it as easy as possible for the airlines to operate jets, because the planes represent a source of considerable revenue for the airport operator. But all jets require careful study for operation in built-up areas, he pointed out.

The British official called "nonsense" a suggestion that British airport neighbors might complain about a Russian or American jet whereas a British jet might be more acceptable to them because of its nationality. Such a suggestion, he added, was "an absurd idea."

Boeing 707 Mishap

Long Beach, Calif.—Boeing 707, with Pan American World Airways markings, scraped the lower surface of the right wing when airplane landed at Municipal Airport here for an appearance during static display of national summer meeting of Institute of Aeronautical Sciences.

Boeing test pilot Tom Layne said he used a wing low approach to correct for cross wind. Reports indicated that lower surface of No. 4 nacelle and lower portion of sound suppressor were scratched as well. Airplane flew back to Seattle on schedule.

SHORTLINES

▶ **Allegheny Airlines** flew more than 7,527,000 revenue passenger miles in June to set a new company record for the month. During the period July 3-July 6, Allegheny flew approximately 971,000 revenue passenger miles, an increase of 19% over the 1957 holiday period. Allegheny reports its new nonstop traffic between Pittsburgh and Atlantic City, Wildwood and Cape May, N. J., is exceeding company forecasts.

▶ **Civil Aeronautics Board** has voted to give Frontier Airlines immediate authority to furnish air service between Casper, Wyo., and Omaha, Neb., via Douglas and Lusk, Wyo., and Chadron, Ainsworth, Norfolk and Lincoln, Neb.

▶ **Northwest Airlines'** board of directors has declared a dividend of 20 cents a share on common stock and a regular quarterly dividend of 28¾ cents a share on 4.6% cumulative preferred stock. Northwest had 1,343,120 shares of common stock and 26,455 shares of preferred stock outstanding on June 1, 1958.

▶ **Port of New York Authority** has awarded two contracts totaling $7,141,336 for improvements at New York International Airport. A $6,046,969 contract for paving and utilities for the new $12 million instrument runway and its taxiways was awarded to the Tufano Contracting Corp. and O. & E. Contracting Co. Inc. of New York. Hendrickson Bros., Inc., Valley Stream, N. Y., was awarded a $1,094,367 contract for installation of utilities and paving of roadways and taxiways leading into the 130 acre southwest hangar site.

▶ **Zurich's Kloten Airport** will be expanded, starting immediately, to accommodate Swissair's jet transports on order. The expansion program will cost about $12 million.

▶ **Panair do Brasil**, Pan American World Airways' subsidiary with headquarters in Sao Paulo, Brazil, has sold out its fleet of 13 Douglas DC-3 aircraft to Navegacio Aerea Brasileira. Panair now uses Lockheed Constellations on domestic flights and Douglas DC-7s on European and Middle Eastern routes and Consolidated-Vultee PBY Catalinas on operations up the Amazon.

▶ **Civil Aeronautics Board** last week opened oral arguments on application of four all-cargo carriers for revision of their certificates to make them eligible for subsidy payments. Riddle, Slick, AAXICO and Flying Tiger Line are the carriers involved in the case.

AIRLINE OBSERVER

▶ Watch for an American Airlines' announcement soon on the purchase of the Convair Model 600 jet transport to fill its medium range jet transport requirement. Model 600 incorporates Richard Whitcomb's NACA area rule design (AW July 14, p. 49) and is powered by four General Electric X-220 turbofan engines rated at about 13,000 lb. static thrust. Convair's Model 600 has a higher critical Mach number, higher cruising speed, longer fuselage, higher gross weight and payload than the Model 880 and requires about 1,000 ft. less runway for maximum gross takeoff. Convair now has an intensive sales campaign under way on various versions of the Model 600 design for both military and airline applications.

▶ **Airline first-class traffic continued to decline during June with a 7.8% drop in revenue passenger miles for the month compared to June, 1957. However, a 7% increase in coach revenue passenger miles held the total traffic loss for the month in all categories of traffic to a 1.9% decline. Reflecting this trend, coach available seat miles rose 23.6% for the month as compared with a 1.8% increase in first-class available seat miles. June load factor for coach service was 66.75%, a 10.38 point drop over June of last year. First-class load factor was 60.10%, a 6.22 point decrease.**

▶ Airlines will make a strong bid to introduce revised airport ground control procedures that will permit jet transports to sit out takeoff delays on the ramp with engines shut off. One airline has emphasized that turbojet engines will consume about 2,820 lb. of fuel per hour at idling speeds and that taxiing to runway and takeoff must be conducted without delay. Such procedures will be worked locally between airport operators and the airlines and probably will require special ground holding areas and bypass strips.

▶ **Canadian airline executives have held discussions with Aeroflot on feasibility of a Moscow-Montreal polar route although no formal steps toward a bilateral agreement between Canada and Russia have been made. Facilities required at Moscow for the operation of Trans-Canada Air Lines DC-8 turbojet transports, on order for delivery in 1961, also were discussed during the Canadians' recent visit to the Russian capital.**

▶ Aeroflot is expanding the air terminal at Vnukovo, Moscow's principal airport. Facilities for handling international passengers, including customs, passport inspection and waiting room, have been enlarged to accommodate increased traffic. New facilities are arranged so that international passengers are separated from domestic passengers. Aeroflot is also installing a second paved runway at Vnukovo. The new runway will cross the long-established east-west runway now used by the Tu-104 jet transports. Half-mile of approach lighting has been installed at each end of the east-west runway and GCA-ILS installations have been made permanent, with fixed huts replacing trailers for the operators.

▶ **Lockheed Aircraft Service-International will maintain aircraft of the Airways Modernization Board at the National Aviation Facilities Experimental Center, Atlantic City, N. J.**

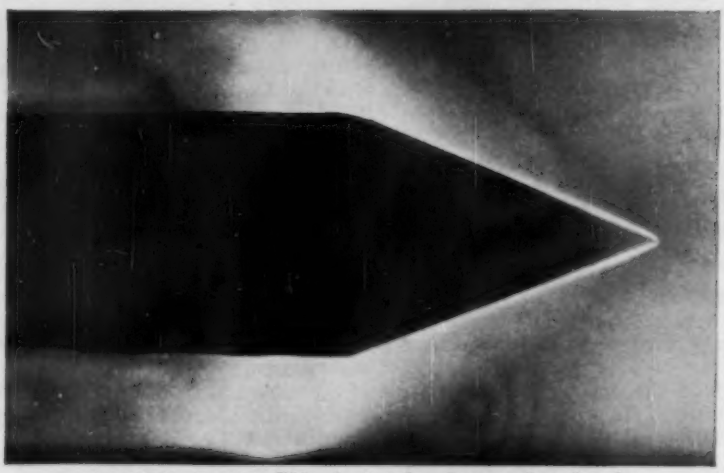
▶ Malev, Hungarian airline, is operating five new Russian Il-14s on which it took delivery earlier this year.

▶ **Watch for an announcement by Vickers-Armstrongs concerning the Vanguard Mark II turboprop transport which will have an increased payload of 5,000 lb. over the original model. Increase was achieved by strengthening fuselage to new zero fuel and landing weights which causes a slight penalty in range. The new model, however, will carry a full load on ranges up to 1,800 mi.**

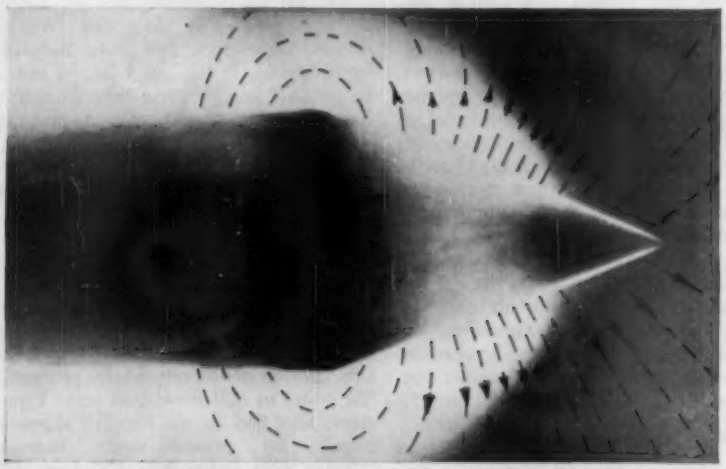
▶ Flying Tiger Line has been discussing with Lockheed a four-engine turboprop freighter with ton mile operating costs of about 3 cents and a payload of 65,000 lb., although empty weight of the plane will be 53,000 lb. Flying Tiger estimates operating cost of the plane will reduce freight rates to 10 cents a ton mile or half the present cost. Aircraft, with a 121 payload ratio, will be the first to fly a payload exceeding the weight of the plane.

PROGRESS REPORT FROM AVCO RESEARCH LABORATORY

NEW LIGHT ON MHD*



NO MAGNETIC FIELD. This shock tube photograph, taken by emitted light only, shows the typical shock wave configuration formed by high-velocity gas flowing around a pointed cone.



WITH MAGNETIC FIELD. Here is shown the magnetohydrodynamic displacement of the shock wave. The magnetic field is caused by electric current flowing through a coil of wire within the cone. This experiment qualitatively demonstrates the interaction of a high-temperature gas with a magnetic field. This effect would be expected to produce drag and reduce heat transfer to the body.

The Avco Research Laboratory was founded a little more than three years ago for the purpose of examining high-temperature gas problems associated with ICBM re-entry. The success of this research led to the birth of a new corporate enterprise, Avco's Research and Advanced Development Division.

The Research Laboratory, now established as a separate Avco division, has expanded to embrace all aspects of physical gas dynamics. We are currently gravid with several embryonic projects which we anticipate will likewise grow into new corporate enterprises. Our work in the physics, aerodynamics and chemistry of high-temperature gases is growing in the following areas:

Magnetohydrodynamics—
Flight and industrial power-generation applications

Space flight—
Manned satellites
Electromagnetic propulsion

These developments have created a number of openings for physicists, aerodynamicists and physical chemists. If your background qualifies you to work in any of these areas, we would be pleased to hear from you.

Arthur Kantrowitz

Dr. Arthur Kantrowitz, Director
Avco Research Laboratory

P.S. A listing of laboratory research reports indicative of the scope and depth of our activities is available. Address your request: *Attention: Librarian, Avco Research Laboratory, 2385 Revere Beach Parkway, Everett, Massachusetts.*

*Magnetohydrodynamics, the study of the dynamics of electrically conducting fluids interacting with magnetic fields.

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FROM AN ORIGINAL PAINTING FOR CECO BY R. T. HANDVILLE

Contributing to superb performance . . . Boeing's 707 Jetliners powered by Pratt & Whitney Aircraft JT-3 turbojets will be equipped (as will many of the JT-4 applications) with *main fuel pumps* engineered and built by Chandler-Evans. CECO, in addition, is producing *cabin temperature control valves* for a number of the 707s which have been ordered by world-famous air lines.

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CECO
SYSTEMS
CONTROLS

Airline Traffic—April, 1958

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	606,740	393,554	64.0	1,691,741	732,868	6,786,727	47,035,207	54.4
Braniff	175,398	74,932	57.8	328,645	134,973	452,226	8,112,502	47.3
Capital	330,662	128,310	56.5	548,709	223,001	325,258	13,384,395	46.0
Continental	63,854	28,617	51.6	98,787	44,223	152,112	3,043,045	43.1
Delta	230,247	119,676	56.9	404,003	227,143	976,587	13,138,547	51.7
Eastern	683,165	399,677	56.87	979,913	401,123	1,118,311	41,040,142	50.97
National	146,336	101,661	57.5	310,845	50,623	526,895	10,740,938	48.1
Northeast	74,607	38,640	50.9	95,468	26,954	119,866	3,945,648	42.0
Northwest	115,363	75,850	51.9	423,305	220,540	840,348	8,772,060	46.7
Trans World	374,884	292,592	63.3	1,111,909	520,333	1,870,126	31,529,946	55.3
United	547,549	380,497	63.6	2,700,762	733,726	4,539,765	44,587,080	56.5
Western†	497	420	65.9	.....	.....	.....	39,868	58.9
INTERNATIONAL								
American	9,855	9,209	49.7	9,048	155	315,364	1,292,130	54.5
Braniff	3,492	6,427	42.1	9,086	.....	107,063	824,250	40.1
Caribbean-Atlantic	23,723	1,637	59.8	1,474	.....	3,435	177,007	69.4
Delta	3,530	4,450	41.8	8,036	.....	53,483	558,861	38.7
Eastern	29,557	38,930	48.20	85,759	.....	86,040	4,202,844	51.26
Mackey	8,093	1,443	39.3	.....	.....	812	164,401	42.4
National	3,261	1,948	23.2	6,243	3,836	23,525	241,984	23.3
Northwest	10,536	23,923	49.0	1,105,502	17,243	630,898	4,307,023	59.6
Pan American								
Alaska	2,820	3,215	49.9	31,643	.....	203,254	560,257	53.5
Atlantic	92,123	113,516	54.5	1,160,655	.....	1,992,310	15,139,558	52.9
Latin America	80,040	86,433	57.5	344,034	.....	3,997,154	12,850,870	59.6
Pacific	22,039	82,978	74.7	1,014,607	.....	1,364,966	11,153,045	68.7
Panagra	11,031	12,448	51.5	65,422	.....	423,923	1,864,928	56.8
Resort	.....	.....	....	.....	.....	3,794,475	3,794,475	79.4
Trans-Caribbean	4,231	6,805	91.7	.....	.....	8,025	576,424	78.8
Trans World	24,241	61,749	49.5	937,408	.....	588,523	8,047,560	51.6
UMCA‡	151	50	35.7	.....	.....	1,503	6,545	42.7
United	6,631	16,474	56.7	106,696	.....	80,875	1,876,322	55.4
Western†	.....	.....	....	.....	.....	.....	.....	....
LOCAL SERVICE								
Allegheny	38,142	6,580	45.7	10,585	14,880	15,401	669,056	45.5
Bonanza	16,770	3,854	49.8	5,102	2,411	7,855	381,562	47.5
Central	10,647	2,048	34.2	4,417	2,177	6,539	209,324	30.6
Frontier	19,413	5,886	53.3	22,582	9,616	45,698	643,334	61.1
Lake Central	14,100	2,262	35.1	3,473	12,343	.....	232,213	37.4
Mohawk	37,771	7,073	51.7	7,697	12,117	13,054	708,537	51.8
North Central	58,447	9,570	45.5	24,224	26,244	.....	969,293	46.1
Ozark	34,074	5,579	43.5	11,590	13,592	10,938	569,488	45.0
Pacific	30,724	6,829	52.3	11,147	5,758	5,640	673,781	50.3
Piedmont	33,524	6,676	50.5	13,998	9,287	8,895	672,675	49.9
Southern	17,707	3,202	37.6	8,417	7,707	5,048	328,134	37.3
Trans-Texas	18,600	4,158	35.8	13,654	7,471	25,274	444,604	36.7
West Coast	19,732	3,602	45.62	4,761	3,004	5,566	357,303	43.38
HAWAIIAN								
Hawaiian	32,533	4,808	63.6	4,874	.....	130,539	521,989	58.6
Trans-Pacific	16,764	2,239	60.0	728	.....	7,628	187,757	58.9
CARGO LINES								
AAXICO	.....	.....	....	5,158	10,843	3,475,551	3,491,552	82.99
Aerovias Sud Americana	.....	.....	....	.....	.....	790,600	790,600	82.3
Flying Tiger	7,404	29,254	100.0	44,522	61,061	8,202,771	11,233,766	....
Riddle*	.....	.....	....	.....	.....	1,314,438	5,357,449	73.59
Seaboard & Western	10,507	40,374	100.0	.....	.....	578,580	1,443,702	100.0
Slick	1,585	8,651	100.0	.....	.....	.....	16,315	33.0
HELICOPTER LINES								
Chicago Helicopter	8,417	151	41.0	1,875	1,898	.....	15,691	58.2
Los Angeles Airways	2,490	96	52.5	4,609	918	498	14,382	43.3
New York Airways	6,235	119	42.3	1,654	.....	193,434	462,983	38.7
ALASKA LINES								
Alaska Airlines	5,223	2,199	28.0	46,991	.....	193,434	462,983	38.7
Alaska Coastal	3,813	357	64.7	3,304	.....	4,498	44,678	67.7
Cordova*	.....	.....	....	.....	.....	.....	.....	....
Ellis	3,388	204	56.3	1,981	.....	2,789	25,614	70.7
Northern Consolidated	1,344	466	37.5	31,804	.....	46,034	128,670	56.0
Pacific Northern	7,266	6,504	38.5	87,816	.....	205,669	1,001,373	47.5
Reeve Aleutian	963	685	38.8	20,599	.....	110,429	206,081	50.0
Wien Alaska	2,368	839	32.3	32,934	.....	150,378	269,729	61.1

* Not available. † Western Airlines' strike—2/21/58 to 6/1/58. ‡ Uraba, Medelin & Central Airways.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

CONVAIR
240
CONVAIR
340
METROPOLITAN
440

the

NEW CHALLENGER

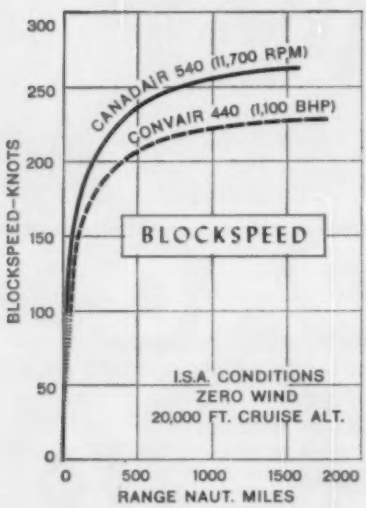
–Ahead in Blockspeed

–Ahead in Payload

and NOW–Canadair

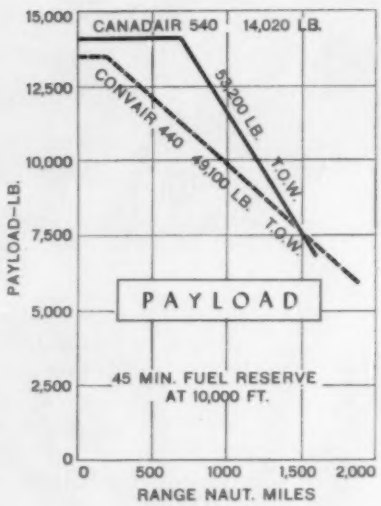
540 TURBO-PROP

For short-to-medium routes



Graph at left shows the significant improvement in speed available in the turbine-powered "540" compared with the "440"—as much as 34 knots at a range of 1000 nautical miles.

Graph at right shows that the earning potential of the "540" is greatly increased. It is capable of carrying 48 passengers, plus their baggage, plus 4210 lbs. of cargo (total payload: 14,020 lbs.) a distance of 680 nautical miles. This represents a payload increase of 365 lbs. over the "440", and a range increase of 500 nautical miles.



Furthermore, with its Napier Eland turbine power, the "540"s max gross weight is increased 4100 lbs. over the "440" (up to 53,200 lbs.) . . . and the "540" can reach cruising altitude of 20,000 ft. in half the time (15½ mins. vs. 35 mins.). The "540" builds on the well-known and excellent record of the "440", and is altogether a new airliner unsurpassed in performance characteristics and earning power.

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CA58-CL66-87UST

Idlewild Moves Toward Automation

By Glenn Garrison

New York—Steps toward automation of air traffic control will be taken here this month when New York's Air Route Traffic Control Center makes the first operational installation of a computer for this use. The Remington Rand UNIVAC Model 1 file computer is expected to be in service in October. A second UNIVAC will go into air traffic work at Washington's route control center shortly after the New York installation.

The New York center, relocated in early 1956 from La Guardia Airport to the new Civil Aeronautics Administration building at Idlewild (AW Jan. 16, 1956, p. 126), already makes use of an IBM Cardatype accounting machine to print its flight progress strips automatically. UNIVAC will take over this printing job and include estimated times over check points, now computed and inserted manually by controllers.

The computer also will prepare a message for the adjacent control center when a flight is to be passed from New York control. When Washington's computer is in, this communication is expected to be two-way and completely automatic, with message cards converted to punched teletype tape and back to cards again at the receiving end.

After this first phase program for the UNIVAC, further uses will be sought for it in the control system. Future programming plans—by no means firm or imminent—may include possible conflict detection by the computer to sound the alarm when aircraft are on collision courses. More likely in the near future, is automatic revision of flight data on the strip postings.

Free Controllers

Main service UNIVAC will perform during the first phase will be to free assistant controllers from the task of computing times and handwriting information on the progress strips. The assistants then can spend more time handling such matters as telephone communications, thus in turn freeing controllers of these chores.

The Idlewild center, CAA's busiest, badly needs relief from its work load, which has almost doubled since the move from La Guardia two and a half years ago. Peak number of fix postings handled by the center in any one day at La Guardia was about 7,500; the new peak days approach 15,000 fix postings.

The recent introduction of various forms of positive control of traffic in VFR weather has contributed to this work load. Posting on VFR days before positive control ran about 6,000 on the average, according to Chief Controller J. J. Boyle. The figure is now around 9,000 on VFR days. IFR peaks increased to 15,000 from about 13,000. The airlines' all-weather IFR flight planning instituted about a year ago along "Golden Tiangle" routes connecting Washington, New York and Chicago has had less impact on the center's load than recent positive control measures, Boyle says.

Increasing volumes of domestic and international traffic converging on the New York area have been handled by the center with a minimum of delay, Boyle reports. Shortly after moving into the new and greatly improved quarters at Idlewild, the CAA controllers began the first operational use by a traffic control center of Terminal Area Surveillance Radar, making possible radar traffic control in the area.

The radar, allowing aircraft separation of five miles instead of 10 min., has cut departure delays "almost to zero," Boyle said. In pre-radar operations delays of 30 to 60 min. were frequently accepted. Now, Boyle said, any delay of more than 20 min. at most is very unusual.

Radar controllers work with two kinds of scopes fed by the General Electric FPS-8 radar's antenna. In addition to its own FPS-8 vertical scope, the horizontal VG-1 scope allows controllers to place markers on the table-top face of the scope and move them along with the aircraft for quick identification. The VG-1 scopes are worked at an 80 mi. scale; radar's maximum range is about 150 mi.

Area presented on the VG-1 scopes is divided into five traffic sectors, each worked by a control position with its own repeater scope. Alongside controllers at one of these positions is a closed circuit television receiver, and a TV camera points down at the face of the scope taking continuous pictures for transmission to a receiver in Idlewild's control tower. This adds visual information to the verbal communication via loudspeaker between tower and center controllers at their scopes. The TV screen is a replica of the scope, and a center controller can watch a tower controller point to an individual target, or vice versa. This system is still under evaluation.

Three additional VG-1 scopes will be installed in the near future to display information which will be supplied to the center by an Air Defense Command radar at Palermo, N. J. via microwave link. This "filler" radar, it is hoped, will link New York and Washington centers with continuous radar coverage. Long range planning calls for another filler radar to be tied in from Montauk Point at the tip of Long Island, extending the chain to the Boston center. This may be in use in 1960.

Another improvement in the New York center was the provision of new radio frequencies for direct communication. At La Guardia, there was only one channel available; there are now over 50.

The Cardatype has been in use about 18 months in the center. When a flight plan arrives by teletype from an airline, a center controller pulls a pack of cards representing the route desired, with fixes already punched onto the cards. Each card represents one fix. The card pack is inserted into the machine, and variable information such as aircraft identification, type, speed, altitude is punched into the IBM along with the cards. An automatic typewriter then prints a flight progress strip for each card, i.e., each fix.

Control Area

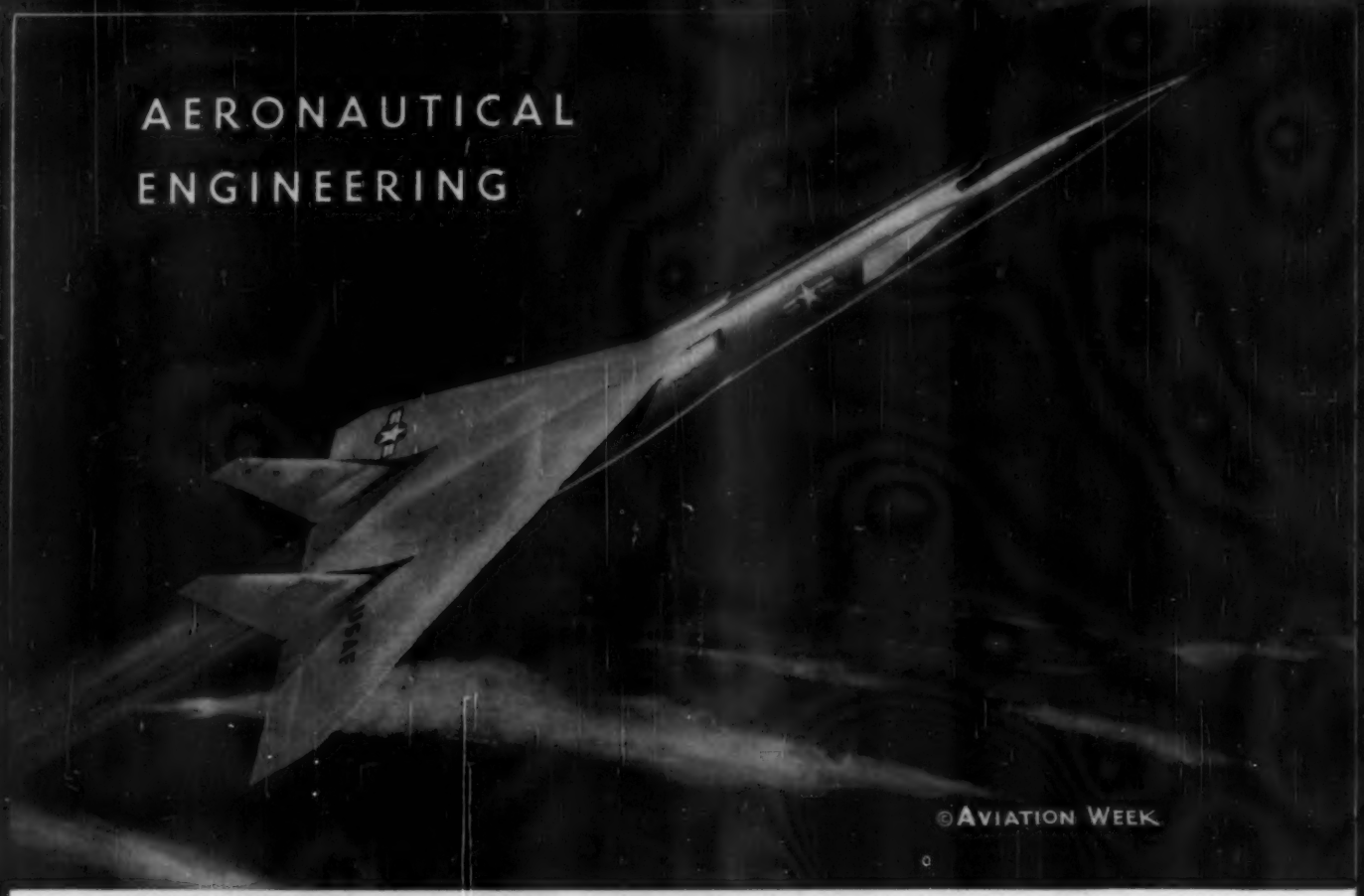
The center's control area is bounded roughly by Salisbury, Md., to the south, Hartford, Conn., to the north, and Brookville, Pa., to the west, plus a zone 100 mi. offshore with the oceanic sector taking over from that point. The area is broken down into 18 sectors altogether and flights are passed from one sector to another within the center.

The oceanic sector's workload is traffic along routes to Bermuda, Puerto Rico and the Azores. North Atlantic traffic, as far as the New York center is concerned, is for the most part handled as domestic traffic and turned over to Boston or Gander centers. Reason is that these transatlantic routes stay largely within the 100 mi. offshore zone until they reach the other centers' control areas.

A group of New York's controllers have been training for the UNIVAC operation since January, and have programmed the computer for the first phase of use.

Six flight data positions are being set up to service the UNIVAC. Flight plan information will be converted into punched cards and introduced into the computer. UNIVAC will then access flight data from its memory drum and automatically type flight progress strips with the corresponding computations included.

Staff in the Idlewild center now numbers as many as 90 men on some watches, up from a maximum of 50 in the old quarters at La Guardia. There are 42 journeymen positions in the center, five supervisors, 45 assistant controllers.



AVIATION WEEK artist's conception of the F-108 long range interceptor. Two Mach 3 F-108s may be fabricated in 1960.

Economy Critical in Mach 3 Transport

This is the second of two articles on Mach 3 aircraft. The first article appeared in last week's AVIATION WEEK.

Washington—Aircraft industry studies indicate that a Mach 3 commercial transport not only is feasible with respect to structural design and propulsion requirements, but that seat mile costs may be substantially lower than with subsonic jets.

The same general provisions which make possible efficient design of Mach 3 manned military aircraft apply to Mach 3 commercial transport airplanes. In the latter, however, economics is a more critical factor.

Experience with operational Mach 2 fighters and Mach 4 ramjet test vehicles indicates that efficient lift-drag ratios can be realized for high supersonic transport operation. For the over-all approach to the Mach 3 transport, however, design experts feel that this supersonic carrier will require the most brilliant engineering ever designed into a commercial configuration.

Although specific design details have not jelled for the Mach 3 transport, it is conceded that the over-all configuration will be radically different from today's transport forms. By present standards, the wing will be extremely thin, making it impractical for storage of fuel as in present-day transports. This will introduce a precedent in transport design by making it imperative for a section of the fuselage to carry the fuel. To meet this requirement, fuselage will have to be deepened or extended.

Fuel in Fuselage

Present indications are that storage of fuel under the fuselage floor will not be the safest, most practical location, leaving the alternative of a separate extensive fuel bay added to the fuselage aft of the passenger cabin, with a separating bulkhead sufficiently strong to take all sloshing and decelerating loads. This will mean an unusually long fuselage by present standards. While storage of fuel in the fuselage may create some misgivings among airline operators and the traveling public, the feeling is that this location is safer than wing fuel storage.

These fuel limitations may also be applicable to military designs in the Mach 3 category. If additional fuel is carried in external stores, such as tip tanks or suspended pods, this procedure would appear practical only for military use.

One of the big factors in the Mach 3 transport will be the problem of cockpit and cabin cooling in view of the high heat of incoming air normally used for cooling and the high skin temperatures generated by the high cruise speed. Insulation provisions will be adequate to meet the task but, in addition, refrigeration requirements will be boosted to cool incoming 500F air down to a comfortable 70F for the 85 to 100 passengers carried by the Mach 3 transport. Opinion is that the refrigeration system will have a vastly larger capacity than any installation used for aircraft in the past.

The transport probably will need no heating system. This will eliminate the weight involved in heating provisions for present passenger cabins. Absence of a heating system also will eliminate fuel requirements for heating—another substantial weight saving. Probably only a small heater will be required to service the airplane while on the ground in winter, and perhaps a ground-cart heater could do the job.

A contingency of decompression at

60,000 to 70,000 ft. altitude, probably the cruise level for a Mach 3 transport, will prompt transport designers to initiate extreme measures for passenger safety.

One provision that is likely to be introduced is the use of smaller and thicker passenger-cabin windows.

The steep climb of the Mach 3 transport will also introduce a condition strange to today's passenger. The angle of the floor will create a new sensation during a walk between forward and aft cabin, and passengers probably will be required to remain seated during the entire climb.

First Mach 3 transports may be limited to transcontinental range—about 2,400 mi. along the Great Circle pattern—because of the quantity of fuel consumed in a high altitude supersonic flight.

For transatlantic service, such as New York to London (approximating 3,400 mi. along the Great Circle route), a larger size transport than would be available initially would be required.

If design were to begin on a Mach 3 transport now, one estimate of a time scale indicates production of a prototype in about two and a half years, a year for flight testing, with attainment of line production by 1963-64, and airline operations in 1965.

Design Similarities

Without any relation to any specific design, numerous factors are common to Mach 3 manned aircraft configurations, whether military or transport:

• **Existing runway facilities** will be adequate for takeoff of Mach 3 family of aircraft because of the large amount of thrust available from the advanced powerplants and the large wing area which will be required for low wing loading for high altitude cruise. Since most of the aircraft's load will be in fuel, which will be substantially consumed before letdown, landing weight will be relatively low. This factor, coupled with the large wing area, would make landing no problem.

• **Temperature** probably is the greatest single factor influencing design of the Mach 3 aircraft. Skin temperatures will vary over the surface of the aircraft. Landing edges, wing lower surface, engine areas and intake ducts will show higher heat values. For steady-state cruise, average temperature over the airframe might run 500 to 530F, but some other critical points may climb to 900F.

• **Maintaining** fuel at reasonable temperature, probably by adequate insulation, also will be a prime requirement both from the standpoint of safety and, with respect to both JP types or high energy fuels, to avoid coking on tank surfaces. Coking might introduce the dangerous possibility of the material flaking from the tank and being carried into the lines to the engines.

• **Cooling of equipment** in both military and commercial Mach 3 aircraft will pose a considerable hurdle, but the progressive state of development is expected to be sufficient for solution of the problem. Simplest approach would be to engineer components to withstand heat without cooling. This would be feasible in some instances but most internal installations will require some intensive cooling scheme.

Individual systems will require specific approaches to solve heat problems. In general, various systems for Mach 3 aircraft will involve greater capacity demands and this in turn will introduce necessity to reject considerably more heat, sharply boosting cooling requirement and increasing equipment weight. Probably extensive use will be made of individual refrigerated compartments for critical installations.

• **Circulation cooling** has been considered to promote boundary layer control, because the cool dense layer adjacent to the surface would improve flow stability. The feeling among designers is, however, that the present state of development would not permit incorporating circulation cooling in Mach 3 aircraft. General use of water as the cooling medium probably would introduce too high a weight penalty, but research is being pushed to devise efficient methods for use of circulation cooling, because substantial benefits would stem from successful solution of the problem.

• **Electrical system** insulation material may require ceramic coatings. Rotating machinery probably will require special treatment, since opinion is that the limit of usefulness of organic lubrication compounds is being approached. A number of schemes are under consideration, including development of high temperature greases, dry film lubricants and use of dry bearings, perhaps of a ceramic material.

• **Hydraulic systems** will require lines not only able to withstand high heat but to carry substantially higher pressures as well.

• **Marking materials** for external use, such as insignia or instructions, probably will be a ceramic type.

• **Ceramics will be used** in radomes and antenna because of heat generated in Mach 3 service, designers believe.

• **High-temperature glass** probably will be used in canopies as well as windscreens in double thicknesses with space between them for thermal insulation. Surface likely will avoid compound curvature, will consist of a series of flat planes to obtain good optical characteristics. Big problem will be design of adequate edge attachments.

• **Airframe of the Mach 3** aircraft will be a substantial departure from the structural makeup of today's high speed plane. Materials are not deemed the most critical problem. Not yet considered to be in the off-the-shelf category like the conventional aluminum alloys, most of the high-heat-resistant high-strength materials required generally are available in sufficient quantity and with adequate producibility for efficient use, but new in-process controls will have to be developed. Biggest problem in connection with high-temperature materials for the Mach 3 aircraft will be their application for efficient design.

• **One feature** of Mach 3 structural design will be extensive use of fusion and resistance welding, which may even be applied to whole fuselage barrel sections. Welding will simplify the problem of sealing cabin areas and fuel bays because temperature limits of available organic sealing materials are being reached or exceeded, designers say. Welding also will promote structural efficiency, since a welded joint will weigh less than a riveted connection. However, over-all structure will include both welded attachments and mechanical fastenings.

• **Heat-resistant** weldable alloys used will include semi-austenitic precipitation-hardening stainless steels and high-strength low-alloy steels.

• **Titanium alloys** in Department of Defense's sheet rolling program probably will be used. The 16 vanadium-2.5 aluminum (16V2.5Al) and 4 aluminum-3 molybdenum-1 vanadium (4Al 3Mo1V) titanium alloys are not weldable, would have to be riveted, likely would be used in areas where sealing is not a critical factor. Weldable titanium alloy in the picture is 6 aluminum-4 vanadium (6Al4V), as well as the weldable all-beta type titanium alloy, such as the vanadium-chromium-aluminum formulation, now under development. The beta alloy, like beryllium, is one of the designer's fond hopes and is projected as the probable material for brazed sandwich from the viewpoint of compatibility of brazing cycle with heat-treat cycle. In general, perfection of brazed and resistance-welded titanium structures are not considered as far along as those using steel makeup.

• **Nickel and cobalt alloys** will be used in high-heat engine areas for such applications as shrouds and heat shields.

• **Beryllium, another material** the designers are studying, probably will not be used in initial Mach 3 aircraft for the simple reason that present development of ductile beryllium alloys in product forms is not considered sufficiently advanced by structural and manufacturing researchers to warrant use as a general structural engineering material. Also, cost is high. However, beryllium's light weight, high stiffness,

high specific heat and corrosion resistance are extremely attractive properties and offer big advantages if the material can be brought along quickly.

• **Bulk of the materials** for Mach 3 aircraft will be in flat rolled form, including light-gage plate, sheet, strip and foil. Big problem in these high-temperature flat-rolled products will be to obtain the material in sufficient widths and lengths, desired flatness and close-gage tolerance. Excess gage, even in thin steel and titanium alloy sandwich structure, can result in significant weight increase.

• **Sandwich structure,** both brazed honeycomb core-to-skin and resistance-welded corrugated core-to-skin types, will be used extensively in Mach 3 airframes. Big advantage of the sandwich is the structural stability obtained with very light-gage high-temperature materials. Configuration gives a smooth surface relatively free of oil-canning and flutter under load. Additional benefit is the insulation effect sandwich structure gives.

• **Detail design** of the structural sandwich to permit efficient unloading will make inserts and edge attachments critical considerations.

• **Reproducible product** as distinguished from the laboratory product, will have to be achieved.

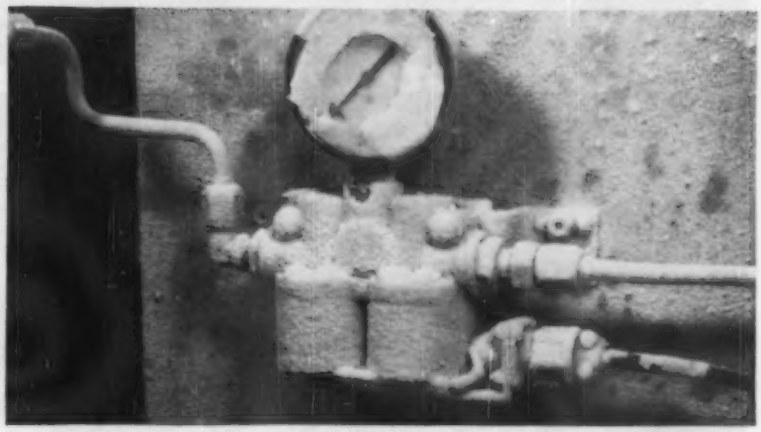
• **Tolerances of brazed** or resistance-welded detail parts will have to be held to a closer degree than on conventional structures.

• **Highest emphasis** will be placed on quality control because inspection of a sandwich structure will not be feasible after makeup.

• **Development of brazing equipment** will get considerable effort. This includes heating media and tooling such as handling, positioning and straightening fixtures. Importance of this aspect for production of Mach 3 sandwich structure is underscored by a proposal for a brazing facility which North American Aviation submitted to the Air Force in connection with its WS-110A weapon system proposal.

• **Heat-treatment** will involve the problem of compatibility of the brazing cycle with the heat-treat cycle. Another consideration will be avoidance of warpage during the heat-treat cycle following brazing and during the welding cycle itself.

• **Problem of handling** steel and titanium alloys for Mach 3 aircraft, both at the supplier's site and in the shop, will be substantially more critical than with today's aluminum alloys. Aim will be to prevent physical damage and contamination, even to the extent of fingerprints, and to avoid reaction effects of general temperature condition and brazing and welding cycles, leading to corrosion and embrittlement. "White glove" handling may be indicated as



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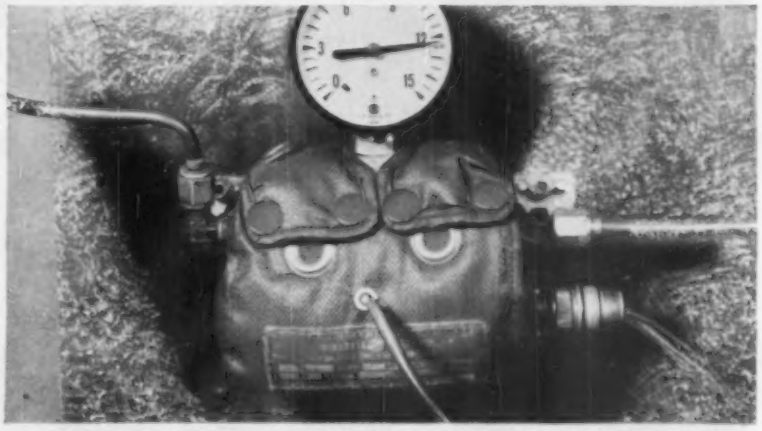

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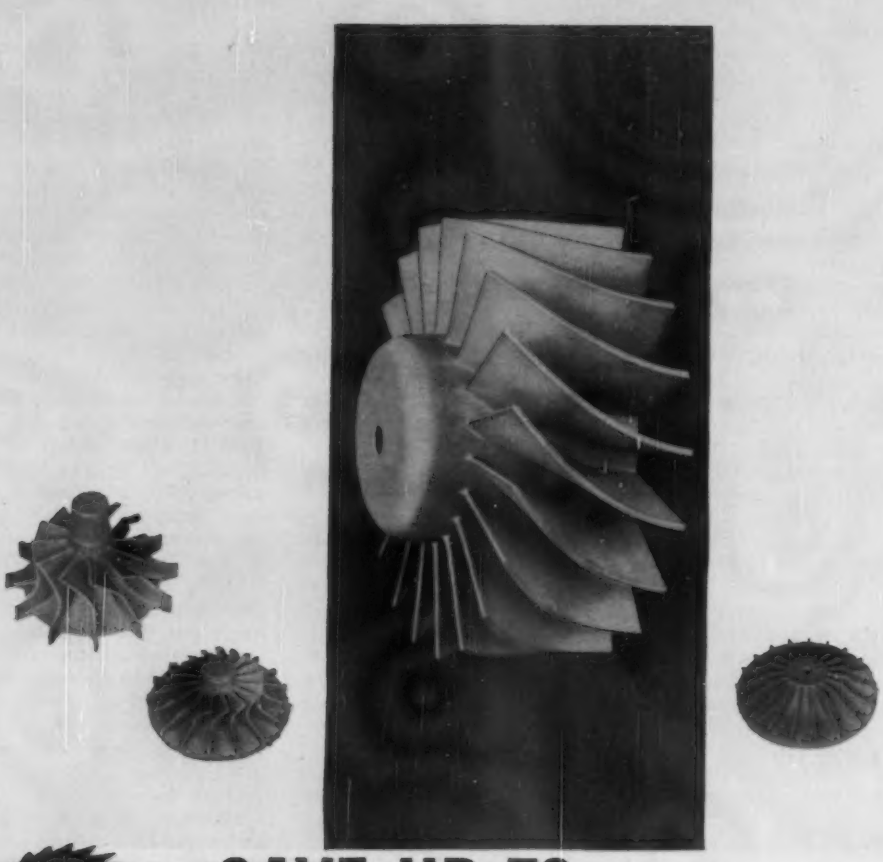

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part of the general education program process engineers feel will be necessary.

• **Specialized facilities** will have to be developed for in-process and in-service repair of sandwich and welded structures. Special jigs and fixtures, even mechanic kits, will have to be devised for the exacting job of repairing the structure without destroying the properties of the original weld or braze.

Bristol Develops Proteus 760 Series

London—Bristol Aero Engines Ltd. announced three new versions of the Proteus 750 engine, to be known as the 760 series. The company says the turboprop engines are designed to provide lower fuel consumption and, with one exception, higher power.

The Proteus 761 incorporates compressor modifications giving a 3% improvement in specific fuel consumption under cruising conditions. Maximum power of the 761 is similar to the 750 but is developed at a much lower compressor rpm. than the 750.

The Proteus 762 is almost identical to the 761 with the exception of a different fuel injection and recalibrated control unit. 5% more power is available for takeoff. Cruise fuel consumption is the same as for the 761.

The Proteus 765 is similar to the 761 and 762 with an increase in cruise power. Cruising specific fuel consumption is the same.

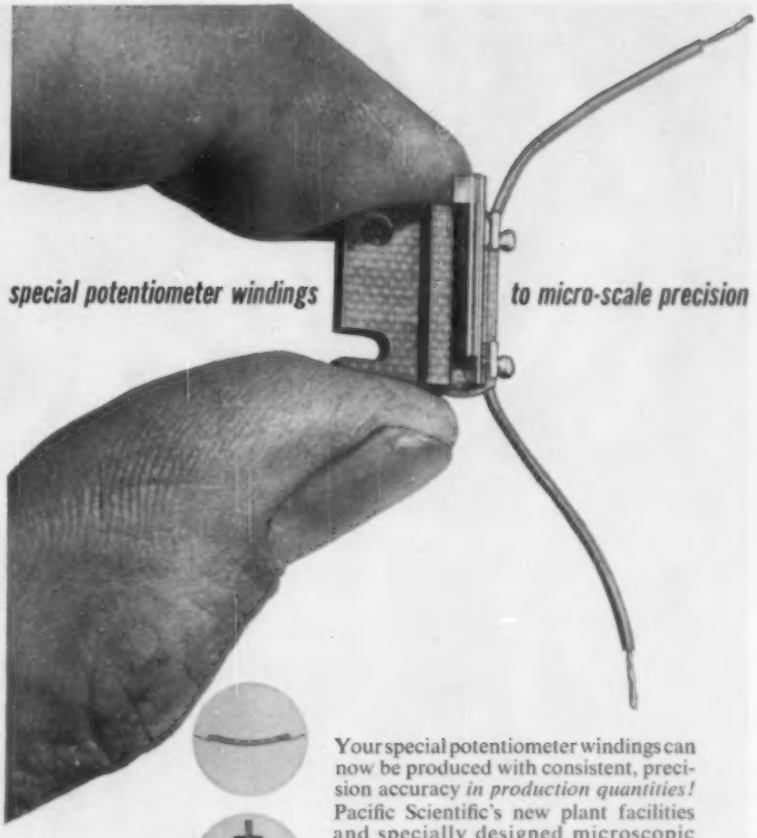
Bristol gives the following performance for the four Proteus engines: Proteus 755 takeoff ratings of 4,160 ehp., 3,705 shp. and 1,180 thrust lb. Proteus 761 takeoff ratings of 4,210 ehp., 3,740 shp., 1,220 thrust lb. Proteus 762 takeoff ratings of 4,350 ehp., 3,870 shp., 1,150 thrust lb. and Proteus 765 takeoff ratings of 4,445 ehp., 3,960 shp. and 1,260 thrust lb.

Cruising specific fuel consumption at 25,000 ft., 325 kt., with maximum continuous power is given as 0.499 lb./hr./lb. for the Proteus 755 and 0.486 for the 760 series.

Upper Air Studies Made Over Argentina

Buenos Aires—Tests of Argentina's upper air were started recently by U.S. Strategic Air Command team to gain precise information about jet streams, clear air turbulence and cosmic radiation in the next 18 months.

Test equipment includes Lockheed U-2 weather research jet, capable of sustained flight above 55,000 ft. U-2 used for sampling atomic radiation, is fitted with test gear by National Advisory Committee for Aeronautics and Wright Air Development Center.



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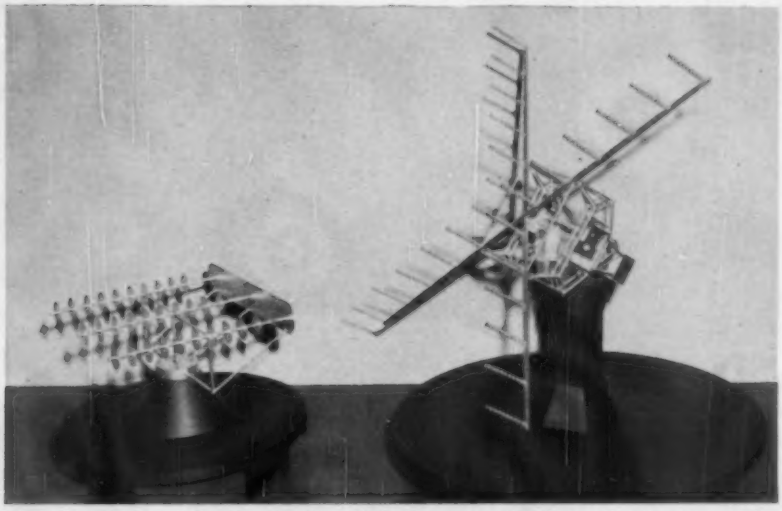
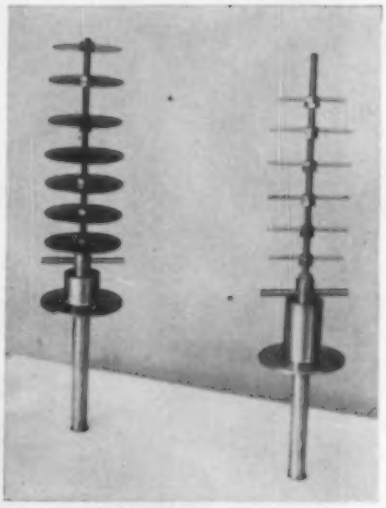




SVE antenna scale models are of a three element array applicable to a low frequency early warning radar (left) and a satellite tracking array which would employ 60 ft. spans to obtain a 1.2 deg. pencil beam. Picture at right compares SVE cigar element with conventional Yagi.

New Antenna Shape Vies With Parabola

By James A. Fusca

Garden City, L. I.—Familiar parabolic antennas used in radar, tropospheric and ionospheric forward scatter communications may face serious competition from a new antenna technique said to offer similar performance for smaller size, less weight and appreciably reduced cost.

Called the SVE (Swept Volume Efficiency) antenna principle, technique has been developed by GB Electronics Corp., a newly formed subsidiary of General Bronze Corp. The SVE method provides for a more efficient use of a group of end fire antenna elements assembled into a broadside array.

The new antenna design concept, according to the company, can provide reductions in the volume swept by rotating antennas of as much as 10 times for large antennas at VHF and UHF frequencies or, conversely, gain improvements of 50-200% in the same volume.

SVE antenna consists of an array of end-fed directional radiators, each of which is made up of an active feed and a number of passive metal disks spaced along a supporting rod to guide the electromagnetic energy into space in a narrow beam.

Improvements Claimed

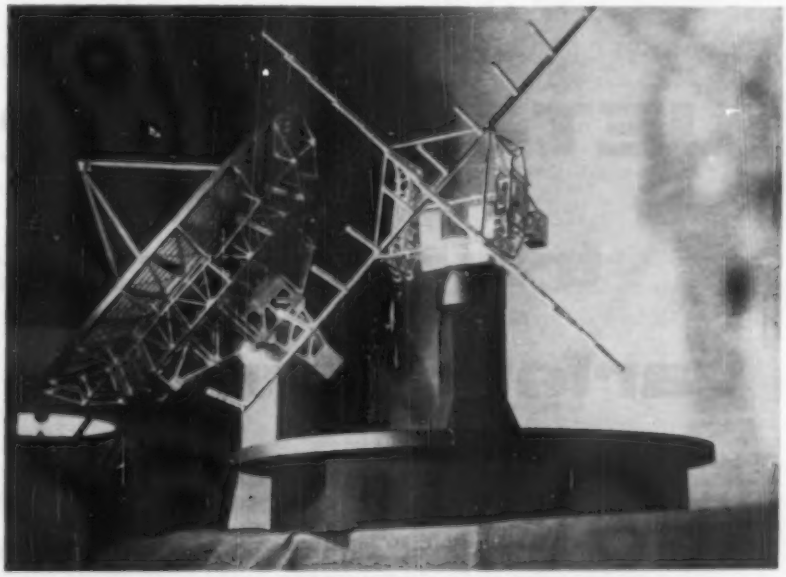
With this technique, the company believes major improvements can be made in the design of antennas ranging in use from airborne early warning radar to space platform communications. For example, specific advantages claimed for the forward scatter type of antenna are:

• **Lower cost.** Simplicity of an antenna array assembled from easily produced elements and requiring only a light mounting structure means that the installed cost of this type of antenna will be very low in comparison with large parabolas.

• **Less weight.** Because this type of array requires only lightweight aluminum antenna elements and supports, the over-all weight will be appreciably less than that of a parabola with comparable performance.

• **Shipping and assembly.** Packed for shipment, an antenna array equivalent in performance to a conventional parabolic antenna 60 ft. in diameter could be shipped in a single aircraft and assembled at destination in the equivalent of two man days.

• **Ease of mounting.** Antenna design is adaptable to standoff installations on slopes or the sides of mountains in re-



MODELS of 60 ft. conventional parabolic antenna and SVE satellite tracking antenna with 60 ft. spars show relative size and weight for same gain, beam widths and side lobe levels.

Venus, in blue light. 200-inch Palomar telescope.

SPACE FLIGHT and NUCLEAR PROPULSION

A drastic reduction in vehicle mass ratios... substantially increased specific impulse values... a capability for achieving very high speeds... these are some of the significant advantages that will come from the application of nuclear energy to space flight.

A number of different propulsion systems have been proposed to utilize nuclear reactions. The simplest system consists of a fission reactor through which the propellant is passed, heated, and then expanded through a rocket nozzle. Fission reactors can also be employed as a source of energy to generate electric power, which in turn can be used to accelerate ions or charged particles, or to create and accelerate a plasma. And fusion reactors, when developed, can be used to generate electric power for the same purposes. In addition, in the case of the fusion reactor, there is the attractive possibility that the reaction energy can be used directly without conversion to electric power.

The fission-powered thermal propulsion system will probably constitute one of the next major advances in space technology. As an example of the gain which can be achieved, consider a vehicle with a payload weight of about 25 tons for a manned flight to one of the nearer planets, landing, and returning. Powered by chemical rocket engines, the takeoff weight for such a vehicle would be 50,000 tons. But powered by a fission-thermal propulsion system, weight at launch would not exceed 500 tons... a 100-fold reduction in the mass ratio. Considerably greater gains are predicted for the more advanced systems.

Systems studies and advanced research in the application of nuclear energy to the requirements of space flight are in progress at Space Technology Laboratories. This work illustrates the emphasis at STL on the exploration and development of new concepts and techniques in ballistic missile and space technology.

Both in support of its over-all systems engineering responsibility for the Air Force Ballistic Missile Program, and in anticipation of future system requirements, STL is engaged in a wide variety of analytical and experimental research. Projects are in progress in electronics, aerodynamics, hypersonics, propulsion and structures.

The scope of activity at Space Technology Laboratories requires a staff of unusual technical breadth and competence. Inquiries regarding professional opportunities on the STL Technical Staff are invited.

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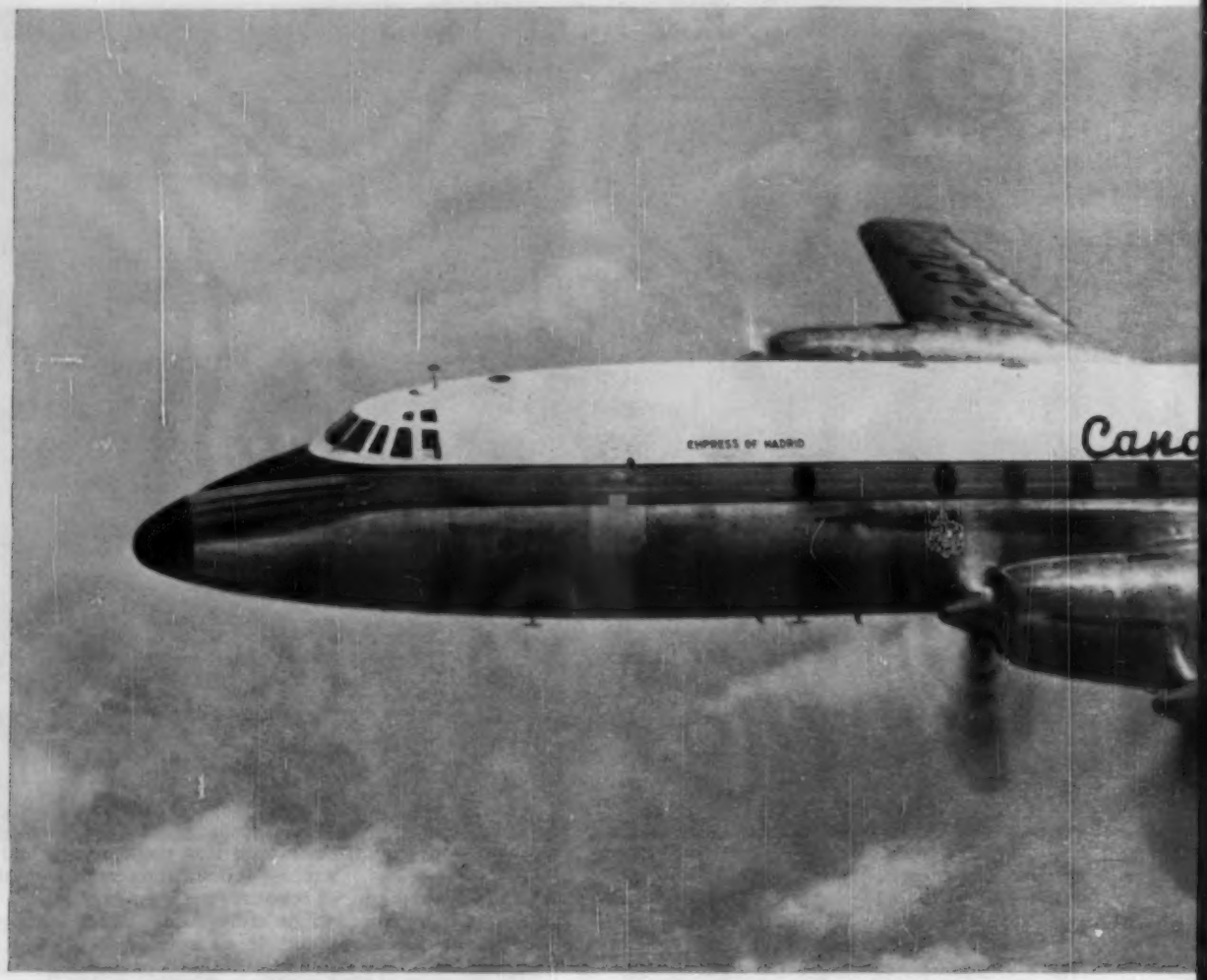

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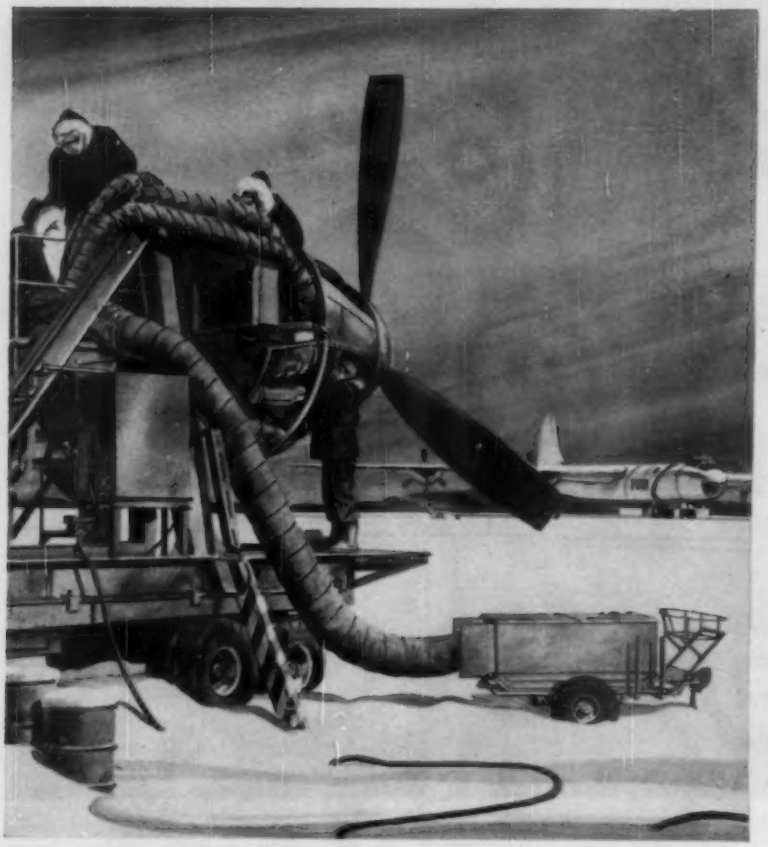

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mote areas. It is mounted on a conventional tower, the tower can be erected with a gin pole, does not require a crane.

• **Environmental adaptability.** In regions where icing conditions severe enough to affect the antenna's impedance matching might be encountered, simple de-icing units requiring only a fraction of the energy necessary for parabolic antenna de-icing can be installed without affecting the performance of the array.

• **Pattern changing.** Antenna array pattern can be adjusted with relative ease so that antenna can be custom engineered to meet the requirements of specific sites.

• **Maintenance.** Simplicity and lightness of the antenna and its support structure will reduce maintenance and replacement costs.

As a manufacturer of large parabolic antennas, GB Electronics Corp. will be competing for its own market with the new SVE technique. While development work at present is under military sponsorship, the company has invested approximately $100,000 in its own development program over the last year.

Among the proposals outstanding for application of the SVE technique at present, are several proposals for rotodomes and radomes for airborne early warning aircraft, antennas for the new European "Ace High" and other tropospheric scatter communications networks, and satellite tracking antennas.

Directivity of all antenna arrays is determined by interference between the propagated waves of electromagnetic energy. By using a large number of sources of radiation, such as the banks of dipoles in a broadside array, it is possible to strongly reinforce the radiation of energy in a desired direction while reducing the radiation in other directions. These sources of radiation may be any type of antenna.

Array Terms

Two terms are important in discussing the properties of antenna arrays:

• **Element function.** The element function of an array is the radiation pattern of a single antenna element such as, for example, the radiation pattern of one dipole of a bank of dipoles used to feed a broadside array.

• **Array function.** The result of combining the element functions of a group of similar elements by multiplying the element function of a single antenna by an array function is to provide the radiation pattern of the group. The group may then be treated as a single source of radiation.

A linear multi-element array consists of a large number of equally spaced antenna elements fed by equal currents in phase to obtain maximum directivity in the forward direction. With this type of array, a great deal of directivity can be obtained, but a larger number of minor lobes are likely to be present.

As the gain required from antenna arrays for radar and communications use has increased over the past several years, an attempt has been made to limit the increase of antenna size by changing from simple antenna elements such as the dipole to "end fire" elements such as the polyrod, the helix, modulated surface wave elements such as the cigar and the ladder, the Yagi, the ferrod, flush slot arrays and others.

Theoretically, the far field radiation pattern of an array of identical elements is the product (in field intensity) of the element factor and the array factor. In the past, this theoretical performance could never be approached using conventional end fire elements which are long with respect to the spacing between them because they generally are of the "leaky wave" type.

That is, they radiate continually along their length which causes interference in the beam formation of adjacent elements, coupling and interaction. One type of element, however, does not display these characteristics. This type is known as the cigar form.

The cigar type of end fire element resembles in some ways the conventional Yagi antenna used for television re-

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Conventionally, the design of this

ception which mounts an active dipole on a supporting rod with several passive directional dipoles spaced in front of it. In the cigar element, the directional rods are replaced by metal disks which direct electromagnetic energy in much the same way, but which have the advantage of propagating any type of polarization.

This cigar type of element can be made to radiate as a true surface wave antenna by adjustment of element parameters. A surface wave propagated along the axis of the cigar element has no radiated component in the transverse direction, which means that the field decays at least exponentially in the transverse direction as it travels along the axis of the antenna until it reaches the discontinuity of the element end where the wave is launched into space

Element Spacing

By spacing elements with a gap of more than one wavelength between them, the far field beam of each element can form with virtually no interaction with adjacent cigars which provides an exceptionally directive beam in both the horizontal and vertical planes. In this case the element directivity varies as a function of length but for a fixed length both pattern and impedance are stable over a relatively broad band of frequencies.

Key to the SVE technique is the development of a cigar element that propagates as a surface wave antenna rather than a leaky wave antenna. Original effort in the program was the mathematical determination of optimum number of disks in an element, element spacing and element length for a specified diameter and side lobe level.

The effort showed that for diameters under 10 wavelengths an improvement could be obtained in azimuth directivity over the performance of conventional end fire arrays employing tapered current distribution while maintaining the same side lobe level, plus an additional increase in gain obtained through the use of longer and more efficient elements. For diameters of over fifteen wavelengths, some reduction in azimuth directivity was predicted mathematically but the over-all gain improvement extended to much larger diameters.

First array built was a model designed to operate at 2,000 mc. Its diameter (swing circle) was four wavelengths. Three elements were used, each 2.25 wavelengths long, spaced 450 deg. apart and fed in parallel with equal amplitude. The measured vertical beamwidth was nominally 27 deg., the azimuth beam width 12.5 deg., side lobes 23 db. maximum, and gain 19.5 db.

Side lobes remained under 23 db. over a 15% band, as predicted mathematically. Measured and predicted patterns agreed almost exactly in terms of half power and null beam width, side lobe levels and angular position.

An important feature in terms of pattern band width, confirmed by measurements on the model, is that for any fixed design the element and array factor beam widths vary inversely with frequency so that the ratio of beam widths (for side lobe control) should remain consistent over a relatively broad frequency band.

One example of the application of the SVE technique would be in the design of a large rotating antenna array such as could be used in the rotodome of an airborne early warning radar.

Conventionally, the design of this type of antenna involves placing a number of low directivity elements along the diameter of a circle, with other elements stacked in elevation. To obtain the narrowest possible beam width both in azimuth and elevation consistent with a certain minimum sidelobe level, each of the elements is fed in equal phase and with tapered current amplitude.

Spacing between the elements conventionally is kept below one wavelength to eliminate severe side lobes, and mutual coupling between the elements is taken into account in designing the array to obtain the required

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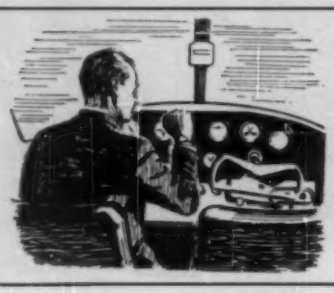
Solo over the Polar Cap...a light plane record!

Peter Gluckmann, San Francisco's Flying Jeweler, is used to accomplishing the impossible with his 225 h.p. Beechcraft Bonanza. And, this Spring, the "impossible" was his daring solo flight over the north polar cap in a single-engine light plane — a world record!

"This was the hardest flight of my life — on me and on my plane," says Mr. Gluckmann. "Every part of the engine had to be in excellent condition and stay in excellent condition — the North Pole is no place to land.

"I used RPM Aviation Oil Compounded because long experience has taught me I can depend on it to keep my engine running smoothly under all flying conditions. "That's the single most important factor in long-distance flying over water, ice caps and mountains. Moreover, in the nine years I've flown my own aircraft on 'RPM' I've had no trouble with sticking valves and rings. That's how RPM Aviation Oil Compounded has saved me hours of costly maintenance work — by keeping engine parts clean and repairs at a minimum."

The polar flight, from Iceland to Goose Bay, Labrador, was a 1,650-mile leg of a 25,000-mile flight through South America, Africa, Europe and back to San Francisco. Mr. Gluckmann also set another record — his was the first solo flight eastward across the South Atlantic, from Recife, Brazil to Dakar, French West Africa.



TIP OF THE MONTH

Mr. Gluckmann advises: "Don't tie yourself down to a rigid timetable. Pushing for that last 100 miles may save you an hour, but it may cost you your life."

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HOW HONEYWELL HELPED VANGUARD I ACHIEVE A NEAR-PERFECT ORBIT

PUTTING a satellite into a long-lived orbit is somewhat like threading a needle's eye—with the needle up in the sky. Vanguard not only had to hit this hypothetical needle's eye but go through it at the correct angle.

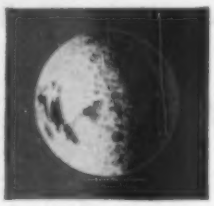
Utilizing no signals or impulses from the ground, Vanguard accomplished this superb feat. Did it with its own powerful rocket engines controlled for most effective utilization by its own complex assemblage of components and systems. The Martin Company, prime contractor, designed and built the Vanguard rocket for, and under the close supervision of, the Naval Research Laboratory.

Vanguard's vital space reference system was Honeywell's contribution. And it was this precise system that, in conjunction with the autopilot, (1) guided Vanguard in the proper flight path, and (2) pitched Vanguard at various angles necessary to achieve near-perfect orbit—so nearly perfect that experts estimate the satellite will remain in orbit up to 200 years.

The turn was accomplished as the diagram at left shows. The total turning angle was achieved within 1% of the angle planned.

The Inertial-type Guidance System, used in Vanguard, is an adaptation of Honeywell's True Inertial System which enables a missile to know where it is—and where it is going—by remembering where it started from. Such systems provide non-jammable guidance beyond the reach of radio or radar.

Inertial Guidance is another example of Honeywell's continuing contribution to space research. If you have problems in the design of systems or components for missiles and aircraft, call or write Honeywell, Military Products Group, 2753 Fourth Avenue South, Minneapolis 8, Minn.



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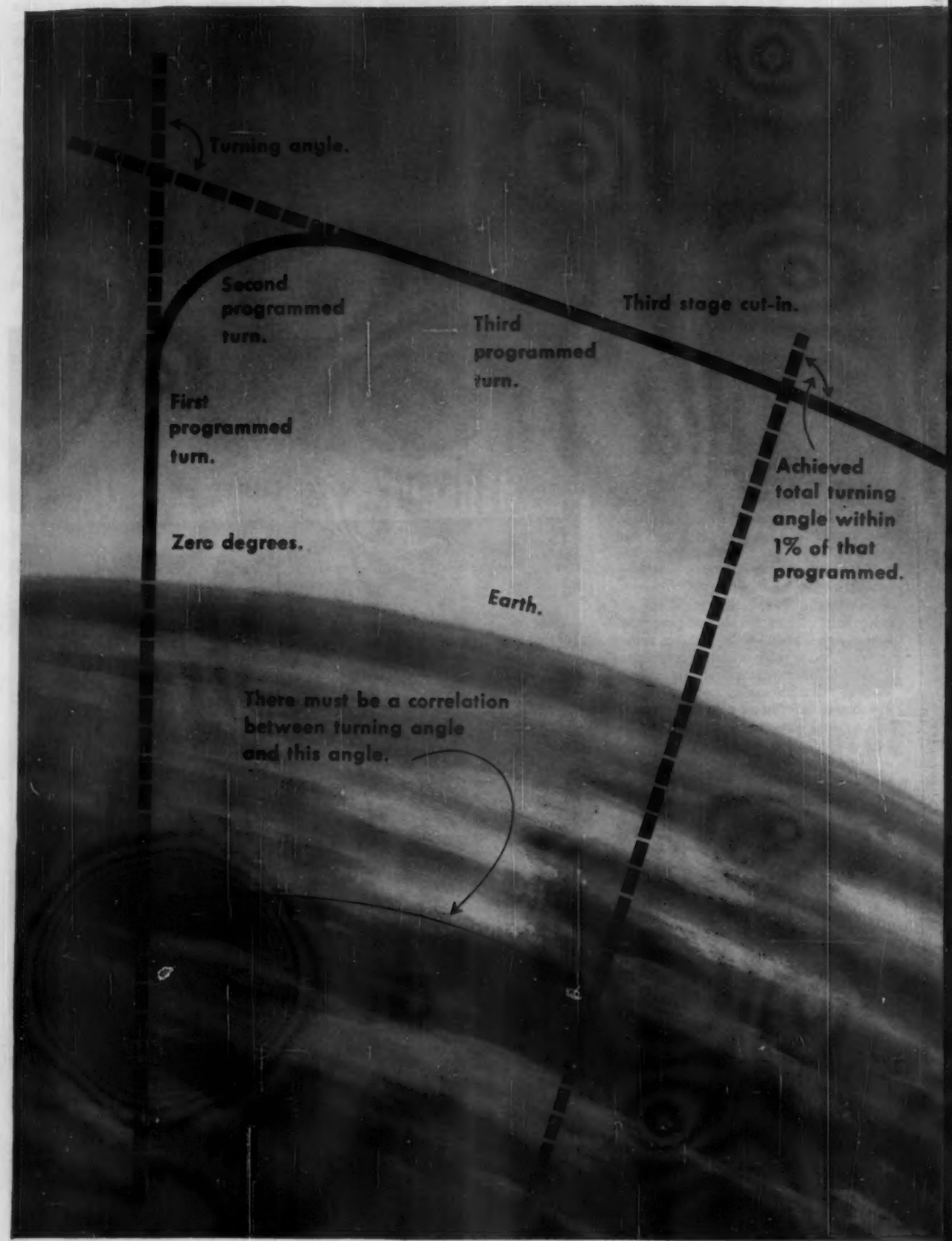
53

HERE IS INFORMATION

amplitude distribution and impedance


Turning angle.
Second programmed turn.
Third programmed turn.
Third stage cut-in.
First programmed turn.
Achieved total turning angle within 1% of that programmed.
Zero degrees.
Earth.
There must be a correlation between turning angle and this angle.

It takes brains . . .

to guide a missile . . . mechanical brains, that is, like this tough but tiny *ARMA* digital computer module. *ARMA* has put a great many brains to work designing a fully transistorized and miniaturized digital computer, a critical part of *ARMA*'s all-inertial guidance system for the Air Force ICBM Program.

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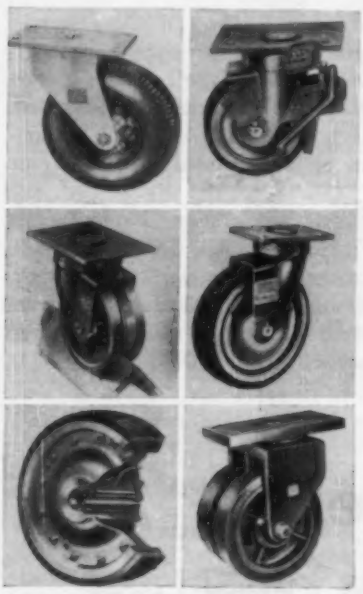

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amplitude distribution and impedance over a band of frequencies. On the assumption that feed losses are low and that high circulating currents do not exist, gain is considered to be an inverse function of the element beamwidths.

As the gain required of airborne radar antennas increased and, therefore, the antenna diameter, this conventional design approach had to be modified to reduce antenna height. A solution adopted was simply an extension of the conventional approach, reducing somewhat the antenna base and substituting longer end fire elements for the low directivity elements. The improved vertical directivity gained as a function of antenna height was at a cost of azimuth directivity. Conventional spacing and large amplitude taper of the low directivity elements was retained.

Instead of extending conventional techniques, however, use of the SVE concept provides an entirely different approach to the problem. Vertical beam width can be reduced by using the longer and more efficient SVE elements. Although lengthening of the elements reduces the available array base size, it can actually decrease the azimuth beam width because of the independent formation of the element pattern.

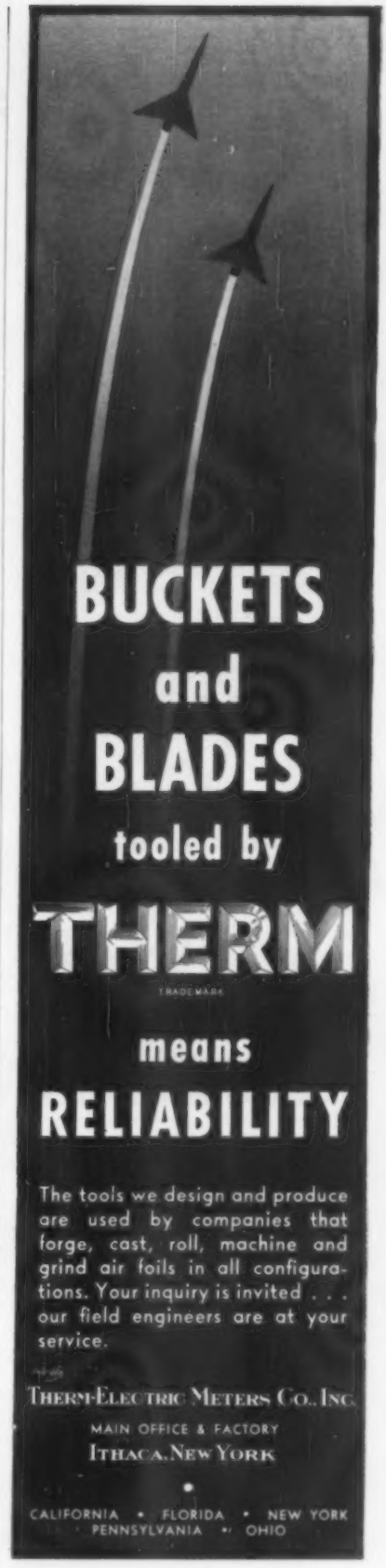
If the element beam width is only a small amount larger than the array factor beamwidth, the array factor and element factor product will exhibit the following characteristics:

- **Product beamwidth** will be reduced below the array factor width.
- **First array factor** side lobe will be appreciably reduced, since it occurs on the skirt of the element main beam.
- **Succeeding array factor** side lobes will be reduced by the generally low element pattern side lobe levels.

Therefore, an appreciably smaller

Thermionic Converter

Thermionic converter the size of a quarter produces electricity when heated by a blowtorch. Developed at the General Electric Research Laboratory, device is a combination of metal and ceramic disks surrounding a high vacuum. It is smaller and operates at a lower temperature (1,500F vs. 3,000F) than gas filled converter announced last year. General Electric estimates eventual power output will be 1 to 10 w. range.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A-C Linear Accelerometer, Type LA-600, for aircraft and missiles. Shown actual size.

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Inherently insensitive to cross-coupling accelerations both when at null and when at an acceleration along its sensitive axis, the Type LA-600 also features magnetic damping for near-constant damping ratio throughout its wide range of operating temperatures. Mechanical stops prevent damage from input accelerations beyond the specified full scale range. Write for Bulletin LA-600, Minneapolis-Honeywell, Boston Division, Dept. 00, 40 Life Street, Boston 35, Mass.

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DESCRIPTIVE DATA

FULL SCALE RANGE:	±0.5 to ±40 G
FULL SCALE OUTPUT:	Up to 10v, 400 cps into 100 K load; Up to 8v, 400 cps into 10 K load
THRESHOLD-RESOLUTION:	.0001G
CROSS-AXIS SENSITIVITY:	.005G maximum
VIBRATION:	10G, 0-2000 cps
SHOCK:	Up to 60 G
WEIGHT:	1.2 pounds maximum

array base can provide an azimuth pattern of the same or narrower beam width with low side lobes while also leaving room for longer elements with a consequent narrow vertical beam width.

Because the elements alone exhibit negligible losses, coupling is negligible and side lobes and cross polarization low, gain is a normal function of beam widths. The gain, therefore, is higher than for a wider beam, conventional antenna.

FILTER CENTER

▶ **New Anti-Jam Radars**—Frequency diversity radars, which operate simultaneously on several frequencies to minimize susceptibility to enemy jamming, are now being purchased by Air Force for air defense use. (For description of a French-developed diversity radar, see AW Jan. 13, p. 79.)

▶ **TAC Control For Mach 3**—New tactical aircraft control and warning system being developed for Tactical Air Command use is designed to track targets flying at speeds up to Mach 3. System will be modulated for air transportability.

▶ **Helpful Tips For Wescon Talks**—Western Electronic Convention (Wescon) has prepared and distributed to more than 200 convention speakers an eight-page booklet filled with useful tips and suggestions for making technical presentations more interesting and effective. Booklet incorporates number of ideas suggested by AVIATION WEEK survey of several hundred engineers who had attended last year's Wescon (Jan. 6, p. 76). Next Wescon will be held Aug. 19-22 in Los Angeles.

▶ **Russian, Anyone?**—Vocabulary of Russian technical terms and expressions, and a pronunciation guide for Russian alphabet are included in July issue of American Society of Mechanical Engineers' journal, "Mechanical Engineering."

▶ **Monopulse For F-105**—Lightweight monopulse radar, developed by North American's Autonetics division for advanced versions of the Republic F-105, can be used for air search, ground mapping, terrain avoidance as well as automatic target tracking.

▶ **Critical Scientific Need**—Lack of suitable instruments and techniques for accurate measurements at temperatures above 1,000F is seriously handicapping efforts to develop urgently needed new high temperature materials, according to Dr. Allen V. Astin, director of National Bureau of Standards. Russian journals report USSR can make regular calibration of temperature measuring devices up to 6,000C, and they plan to increase this figure to 12,000 by 1960, Dr. Astin says. By contrast, U. S. Bureau of Standards can calibrate only to 2,800C within accuracy of 8%, can extrapolate to 4,000C with some sacrifice in accuracy. Another problem area is that of direct force measurement for accurately measuring thrust of rocket engines. Present need is for instruments capable of measurng 1,000,000 lb. of thrust, with error of 0.1%.

▶ **Arinc Doppler Spec**—Arinc Characteristic No. 540, describing airline requirements for airborne Doppler radar, has been approved and released. Copies are available, at no charge, by writing Aeronautical Radio Inc., 1700 "K" St. N.W., Washington, D. C.

▶ **Atomic Amplifier**—New type of two-cavity gas Maser using beam of neutral ammonia gas molecules, reportedly first of its type to exhibit unilateral gain, has been developed by Philco Corp. under Army Signal Corps sponsorship. Gaseous beam connects to electrically isolated cavities, providing separate input-output terminals. Philco also reports its gas Maser has demonstrated the predicted physical phenomenon of prestimulation of molecules in an excited state, which promises greater degree of freedom for controlling the gain-band width properties of such devices.

▶ **Orchids Due**—Recent Electronic Components Conference in Los Angeles not only handed out conference proceedings containing technical papers at time of registration, but published proceedings in convenient book size with permanent hard cover. Proceedings, published by AC Book Co., GPO Box 1151, New York 1, N. Y., are available for $6.00.

▶ **Signed On Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **Ramo-Wooldridge Corp.** has received $13.5 million contract for automatic data processing system to be installed at Army Electronic Proving Ground, Fort Huachuca, Ariz.

• **Packard-Bell** reports $7.3 million contract from Douglas Aircraft for ground support equipment for Thor intermediate range ballistic missile, bringing its total contracts for such equipment to over $14 million. New award is largest single contract ever received by company, which has taken on additional 50,000 sq. ft. of facilities for its Technical Products division to produce equipment.

• **Stavid Engineering, Inc.**, has new Navy BuShips contract for $1.2 million

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for dynamic test and simulator equipment for radar course directing centers.

• **Hamilton Instrument,** Denver, reports a $5.5 million award from Hughes Aircraft for airborne signal data recorder to be used in Falcon air-to-air missiles. Transistorized device will record armament control signals sent to Falcon in flight to prepare it for firing.

• **Telecomputing Corp.,** Los Angeles, reports $623,000 contract for floated rate gyros from Boeing Airplane Co.

• **Control Data Corp.,** Minneapolis, received Civil Aeronautics Administration contract of undisclosed size to design keyboard console for entering flight plans into data processing equipment used for traffic control.

• **Burroughs Corp.** has received $17.4 million Air Force contract for construction of 24 coordinate data processing systems to be used in SAGE air defense system. Contract raises Burroughs portion of SAGE program to approximately $90 million to date.

• **Allen B. Du Mont Laboratories, Inc.** reports $184,500 contract from Sperry Gyroscope Co. for a closed-circuit television system to be used for radar boresighting and tracking of aerial targets.

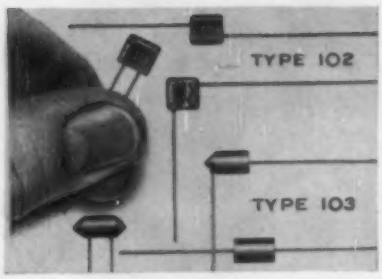
NEW AVIONIC PRODUCTS

Components & Devices

• **Circuit protective device,** Form 101, becomes current limiting at about four times its normal current rating, preventing the rise of fault currents to destructive maximums. Unit is available in capacities and sizes for use in 65-130

v. and 250 v. circuits in rectifier and electronic applications. High capacity and current limiting ability permit its being connected directly into circuits with short circuit currents to 100,000 amp. Chase-Shawmut Co., Merrimac St., Newburyport, Mass.

• **Subminiature wire-wound resistors,** Types 102 and 103, operate through the temperature range from 65C to 125C with standard temperature coefficient of ±15ppm., power dissipation of 0.15 w. Type 102 is available in values from 1 ohm to 1 megohm, Type



103 in values from 1 ohm to 500,000 ohms, both with tolerances of ±0.05%. Ultronix Inc., 116 South Bayshore Boulevard, San Mateo, Calif.

• **Power supply,** which weighs 5.5 oz. and occupies 5 cu. in., will supply 60 ma. at 300 vdc. from a 115 volt, 400 cycle a.c. input. Unit is qualified under MIL-T-5422C, and operates with sufficiently high efficiency so as to result in

almost no internal heat dissipation, according to the manufacturer. Output voltage ripple is less than 5% at full output rating. Master Specialties Co., 956 East 108th St., Los Angeles, Calif.

• **Frequency to voltage transducer,** called Magacycler, converts pulse rate to a directly proportional d.c. voltage or current, providing extended linearity and high temperature insensitivity. Static components give full range linearity of better than 0.5% with temperature variation better than 100 parts per

million, with units meeting more rigid specifications available upon request, according to the manufacturer. Standard outputs available are 0-5 vdc. filtered, 0-200 microamperes filtered, and 0-1 ma. unfiltered. Pioneer Magnetics Inc., 5858 Wilshire Boulevard, Los Angeles 36, Calif.

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Support May Become Key Missile Role

By Michael Yaffee

Soaring costs of ground support equipment are spurring a major evolution in the missile industry that threatens to topple the missile from its preeminent position in program planning.

From the usual situation of devising and adapting a ground support environment to fit a missile, weapons experts soon may be forced to design missiles to fit a predetermined environment. This essentially will be the case with the Minuteman ballistic missile.

Paralleling this development is the growing importance of the ground support producers. Until recently an afterthought in most missile programming, they now are being taken in at an early stage and given an increasingly important role in over-all planning. They have already risen from subcontractors to associate contractors on some programs. Prime contracts seem to be the next step.

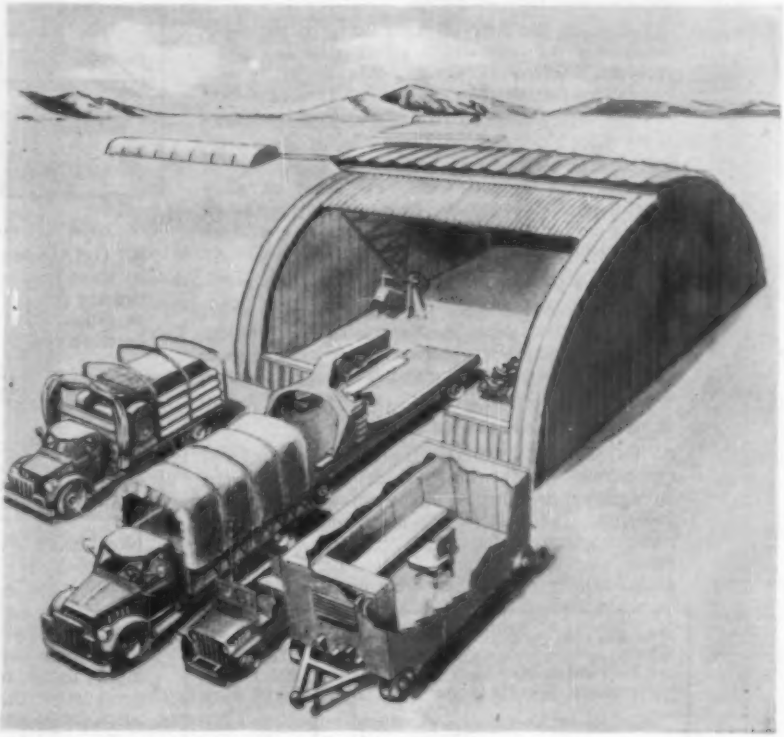
Money is cited as the main reason for the realignment in responsibility. Today's ground support equipment and installations account for almost 50% of total missile cost. Often the figure runs as high as 70%. In the case of the Thor (AW June 2, p. 40), it is 87%.

During the current fiscal year, the Air Force alone expects to spend $943 million for missile ground support. In Fiscal 1960, the figure is expected to jump to approximately $1 billion. This is more than five times the amount required in 1956, more than three times the 1957 figure, and almost twice the 1958 allotment.

Another important factor is complexity. Designing ground support equipment to fit a large, intricate missile often results in complicated units which have high price tags and low reliability. Together they have killed more than one promising missile program.

Conversely, low cost and inherent simplicity of ground support equipment have proved major factors in justifying the existence or continuation of a particular program.

The best way to avoid this double-barrelled drawback, say ground support producers, is to give their companies a free hand from the very beginning of a new missile program—preferably, let them start it. Ideally, they would like to have the military outline the mission, let the companies design the ground support complex and have the other members of the team—i.e., airframe and powerplant personnel, etc.—produce a vehicle that will operate from this complex.



MISSILE shelter for Bull Goose looks like old-fashioned bread box. Trunnion-mounted door rapidly rolls up and back, allowing easy access to missile transporter and other support equipment and fast egress for the missiles.

With the Minuteman, the ground support contractors will get their wish, or at least the closest possible approximation to it. Originated by an Air Force group whose work on an earlier program convinced it that there must be a better way to do things, the Minuteman system is designed for austerity and is expected to be relatively inexpensive compared to either the Atlas or the Titan.

The program planners started with only the roughest concept of the system in mind. Principally, they knew they wanted a deterrent weapon. The question next was how to obtain maximum deterency at minimum cost. The answer was reasoned out as follows:

• **Large number of launching** sites will have to be widely dispersed throughout the United States and loaded with missiles ready to go.

• **Because of the large number** of sites and missiles involved, both should be made as simply and economically as possible. But due to the dominant cost of the ground support environment, it is particularly important that its complexity and cost be kept at the barest minimum.

• **Simplest way to beat** an elaborate and costly launch complex would be to fire out of a hole in the ground. This would eliminate the need for an erector and a gantry. It also would require the least amount of land area and shelter, reduce ready time, and minimize danger or nuisance to nearby areas.

Concealment Easy

Moreover, it would make concealment easy. But because the missile is designed as a deterrent weapon, there is no need for concealment. In fact, one weapon planner suggests that the positions be prominently marked and that a number of false markers be used as well to give the enemy the impression that there are more missiles ready to go than there really are available.

Underground locations, of course, also will introduce problems. Major

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(Above) Crane lowering electrical jumper into position. Cole Connectors make contact easy, fast and positive. (Latching mechanism & supporting plates by Aeroquip)

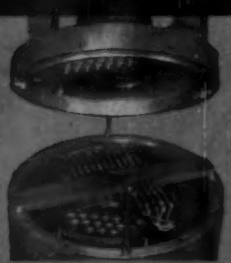
...but even a crane can operate the self-aligning Cole Electrical Connectors!

No human being will enter the heavily-shielded room where uranium fuel from atomic reactors is reclaimed. It is imperative, therefore, that every piece of equipment used is most durable, indestructible, and dependable — and can also be easily operated by cranes or mechanical manipulators.

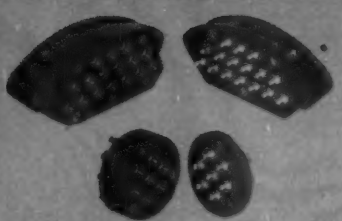
Atomics International* has selected new self-aligning Cole Connectors for the electrical junctions being developed for such a complex installation. This entirely new type of connector does not rely on precision tolerances or screw-type couplings to function properly. The unique two-ball and socket principle of its contacts automatically compensates for imperfect alignment of pins, due to the use of remote control equipment. The Connector withstands rough treatment, high shock and vibration and can be disconnected under load without damage to contacts.

Another important feature of the new Cole Connector is that it can be made in any size or shape required, from miniaturized to high-capacity pins, can make any number of contacts simultaneously (thousands if necessary), yet can be manufactured economically in small numbers. It may be the solution to your connector problem. Send us your requirements and we will determine if and how it can be applied.

*Division of North American Aviation, Inc.



Cole Connectors are used in rectilinear manipulators for fast, easy disassembly and reassembly.



Cole Connectors can be made in any size, shape or capacity and with any number of contacts.

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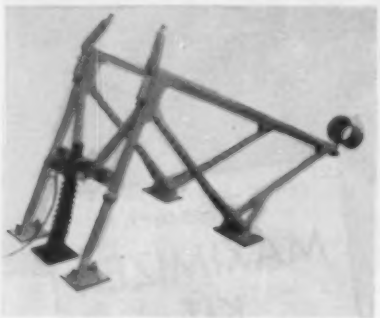
Photos courtesy of Atomics International

EXTREMES in ground support equipment design are represented by complicated and costly Talos land-based launcher (above) and elemental Bull Goose launcher (below).



one is designing a missile to fire out of an excavation. At this point, no one is sure what will happen when a large rocket engine is ignited in a deep narrow pit.

Too, the missile must be designed for vertical storage. Experience gained on the Titan and Polaris programs, should minimize any difficulties here. Venting and other innovations required for underground launchings will not, in the opinion of ground support experts, pose much of a problem either technically or financially.

Some transporters will be needed to carry missiles to the sites and to lower them into the pits. There is no reason, however, why these can't be commercial vehicles modified somewhat for this purpose.

Use of solid propellants will eliminate the need for elaborate liquid propellant storage or generating units and, at the same time, reduce ready time and starting failures.

As far as checkout equipment goes, most of the cost is due to the fine checkout units required to pinpoint malfunctioning areas in the missile. To eliminate this equipment, at least

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Advances in aviation technology have happened so swiftly that engineering materials can no longer be selected for their broad use, but rather for the specific tasks they perform.

Today, in the face of tight budgets, the *right* material is the only sound solution to any given problem. Patch-work design, engendered by second-best materials, can only result in second-best aircraft and missiles in uniquely critical times.

To meet the constant tightening of design requirements, Titanium Metals Corporation of America has opened wide new areas of alloy development. This means: heat-treatable bar stock with *guaranteed* capabilities; higher temperature ceilings; broad new strength ranges.

Q. Are the guaranteed heat-treat alloys new?

A. The alloys are not. They have a production history of four years and a wealth of technical data to support them. Recent development of their full heat-treat capabilities has produced such dramatic results that they are considered new.

Q. What are the heat-treat alloys?

A. Ti-155A (5.5% aluminum; 1.5% iron; 1.5% chromium; 1.1% molybdenum) the highest strength bar and forging stock commercially available; and Ti-6A1-4V (6% aluminum; 4% vanadium), which in the annealed condition has already won wide designer confidence. Samples of *guaranteed* minimum heat-treat capabilities show:

	Ti-155A	Ti-6Al-4V
Section size: Up to 1"		
Ultimate Tensile Strength (psi)	170,000	160,000
0.2% Yield Strength (psi)	155,000	150,000
Elongation, % in 4D (Long)	10	10
(Trans)	8	8
Reduction in Area, % (Long)	20	25
(Trans)	15	20

Detailed information on Ti-155A is presented in a 20-page TMCA Engineering Bulletin. Additional data on Ti-6A1-4V, such as fatigue characteristics and guaranteed heat-treat capability are also available.

Q. Are there other new alloys?

A. The leading alloys nearing commercial volume are Ti-8A1-1Mo-1V, a bar stock offering excellent elevated-temperature creep strength to 1000°F, and Ti-4A1-3Mo-1V. The latter, now being produced and evaluated by the Department of Defense sheet rolling program, is designed to fill the need for high strength sheet alloy which can be formed in solution-treated condition and aged to strengths of 175,000 psi. When compared to other high-strength titanium alloys, Ti-4Al-3Mo-1V combines improved formability with outstanding elevated-temperature strength and stability.

Typical Properties — Ti-4Al-3Mo-1V

Condition	Temp. °F	0.2% YS psi	TS psi	Elong. % in 2"
Solution treated	Room	94,000	135,000	14
Solution treated and aged	Room	163,000	175,000	5
	200	142,000	169,000	8
	400	126,000	152,000	8
	600	111,000	140,000	7
	800	98,000	127,000	9

Q. How will these alloys raise temperature limits?

A. Ti-8Al-1Mo-1V is a good example. Although its short-time elevated temperature tensile properties are similar to Ti-6A1-4V, this new alloy offers as much as a tenfold increase in creep strength between 600°F and 1000°F, as shown:

Creep Comparison Between Ti-8Al-1Mo-1V and Ti-6Al-4V

Alloy	Annealing Treatment	Temp (°F)	Stress (psi)	Time (Hrs.)	Def. (%)
Ti-8Al-1Mo-1V	1400°F (24 hrs) AC	850	50,000	300	0.42
Ti-6Al-4V	1300°F (2 hrs) AC	850	50,000	300	3.6
Ti-8Al-1Mo-1V	1400°F (24 hrs) AC	950	15,000	300	0.16
Ti-6Al-4V	1300°F (2 hrs) AC	950	15,000	300	4.3

Now being evaluated by engine manufacturers, Ti-8A1-1Mo-1V appears to answer the need for light-weight strength at steadily higher temperatures. Data on both Ti-4A1-3Mo-1V and Ti-8A1-1Mo-1V alloy are available from TMCA.

All these excellent new alloys have boosted still higher titanium's major advantages of light weight, great strength, superior temperature characteristics, and outstanding corrosion resistance.

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at the launching site, experts recommend a periodic gross check of the missile to determine whether or not it will fire. This also will remove all requirements for maintenance and maintenance equipment at individual sites.

Another major and expensive problem is reliability. Proposed solution: eliminate the need for it by simplification. When the button is pushed, chances are the missile will fire. If is doesn't start, then try another one.

In the event of war, there will always be a certain number of missiles which won't start. The idea is to have enough initially so that the actual percentage of failure is low. Again, as far as deterrence goes, the number of failures is unimportant; the enemy won't know which or how many of the missiles will abort.

Due to the concept's dependency on large numbers of available missiles, the manufacturers will have to come up with some method akin to mass production for turning out inexpensive missiles, motors and controls. But they would probably prefer this to a highly individual, low volume, low profit program.

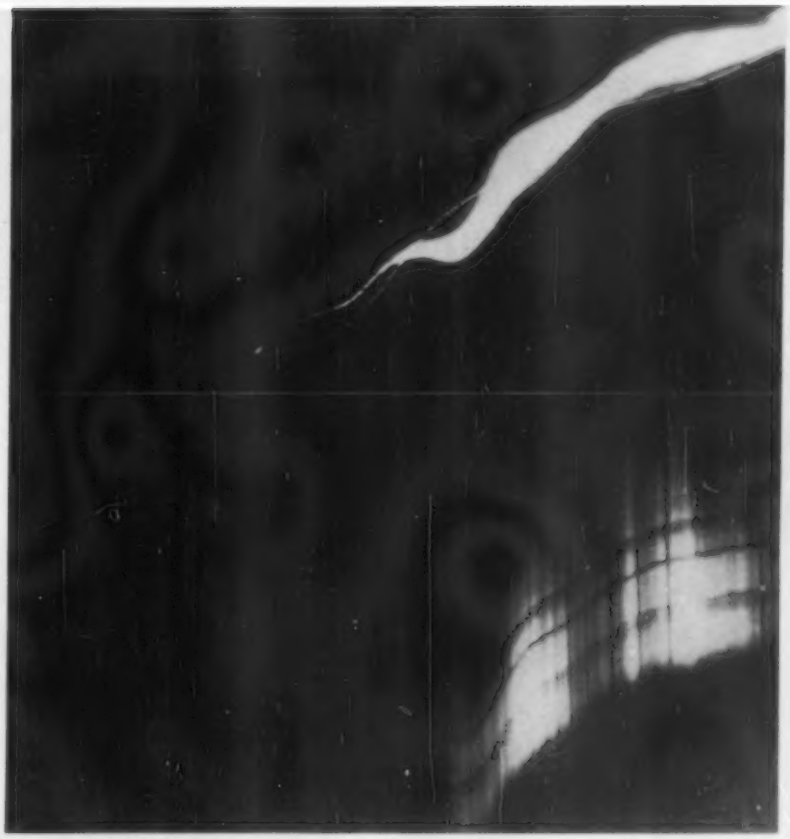
Integral Design

There is a definite possibility that the vehicle could be made up in stages, using "off-the-shelf" units; i.e., existing smaller missiles modified to fit together in an integral ICBM design. Polaris has been suggested as the basic unit in one proposal. It will be a long range, solid propellant rocket, will be fired from a narrow container, and, unlike all other U.S. missiles except the Titan, is designed for vertical storage.

With this in mind, the Air Force planners promoted the Minuteman concept within their own service and then took the ideas to industry. Plans for ground support items were fairly well reasoned out; the problems of the missile itself were touched on. No one presented any major objection to the basic idea of first designing the environment and then fitting the missile to it. And as a result, one important ground support producer claims the U.S. will be getting a new ICBM weapon system at only a fraction of the cost of either the Atlas or Titan program.

While the Minuteman represents the ideal approach to weapon system development as far as the ground support manufacturers are concerned, they believe that it will still be some time before it becomes the dominant one. At the same time, however, they claim they have advanced permanently beyond their previous "postscript" position in program planning.

"The prime contractors or program managers have to call us in at an early stage," one engineer declares. "They



Project Measures Jupiter Re-Entry Radiation

Unexpectedly large amount of radiation was measured from three separated sections of a Jupiter IRBM as they re-entered the atmosphere during first full-scale nose cone recovery test last May 18th. Project, called Operation Gaslight, employed photographic, radiometric and spectrographic techniques to study re-entry phenomena, was directed by Dr. D. D. Woodbridge, Research Projects Laboratory, Army Ballistic Missile Agency, assisted by R. Hembree. Photos above show trajectories of three sections (top) plus spectral distribution of received light (bottom). Wavy trajectory was caused by slight movements of gyro-stabilized gun platform for camera cluster (bottom photo) which is made up of a group of six Barnes Engineering Co. F-8 aerial reconnaissance cameras equipped with spectral gratings arranged to cover a wide sector of the sky.

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can't afford not to. If the costs go too high, they will find themselves without any program at all."

One excellent example of how high ground support costs killed a weapons program is the case of the Talos Land-Based System. The purpose of this program was to develop a high firepower, ground-based anti-aircraft system, on the order of the Nike series, using the Talos missile which already had been developed for shipboard application.

Elaborate Site

The fact that the design of the missile had been definitely established, together with the requirements for a high degree of automation in the ground support equipment, resulted in an elaborate, complicated and costly launch site complex. Given the contract and requirements for the launching system by prime contractor for Radio Corp. of America, for example, American Machine & Foundry Co. came up with automatic, precision equipment that would do justice to a modern oil refinery.

As designed for the land-based version, one launching system (there are two to each Talos Defense Unit) consists of a launcher and a weapons cart. The launcher is located in the center of a concrete blast pit. On the perimeter of the pit are the missile magazines divided into cells according to the type of warhead. In the event of air attack, computers decide which launchers and which types of missiles are to be used. Then the self-powered weapons cart, which also forms a section of the launcher, automatically traverses the pit on rails, enters the proper cell, picks up the missile, returns to the launcher and locks in place. The launcher is elevated and rotated to the computed position and the missile is fired.

The only trouble with the launcher was its high cost—$1½ million. On board ship, where space is limited, this price tag might not prove prohibitive. But on land, says American Machine, it is hard to justify. It would be simpler, more reliable and much less expensive to place a number of missiles on cheap individual launchers. That way, if a launcher fails, only one missile is grounded. Moreover, it would eliminate costly concrete missile magazines, blast pits, rail lines, weapon carts and associated control systems, checkout equipment and servicing units.

The Army, designated using service for this system, recently canceled its contract for the system with Radio Corp. of America. There is little doubt that high cost was a major factor—if not the controlling one—in the decision. By the same token, a number of engineers feel, a less elaborate, less costly ground support complex would

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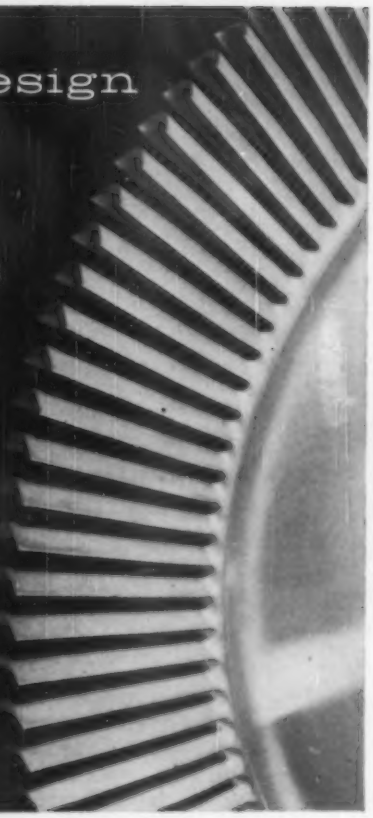

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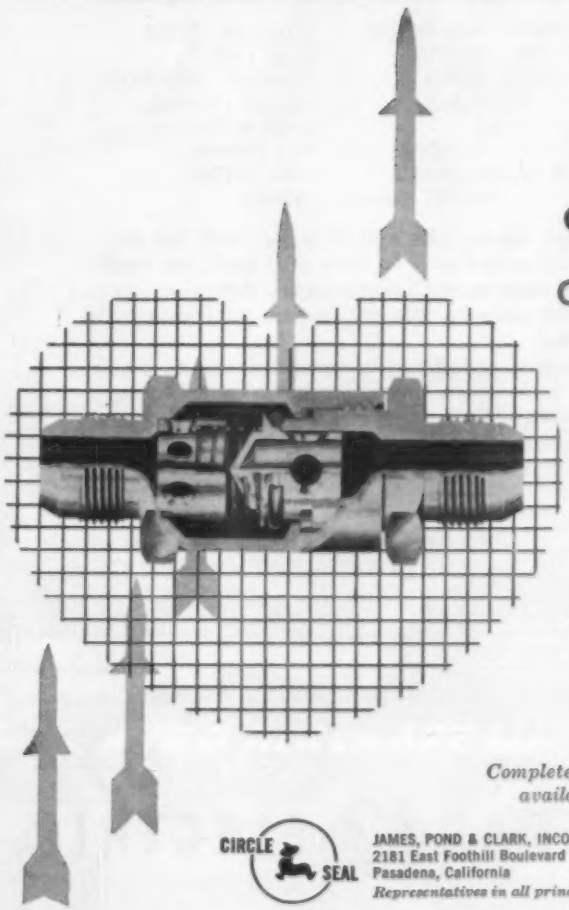

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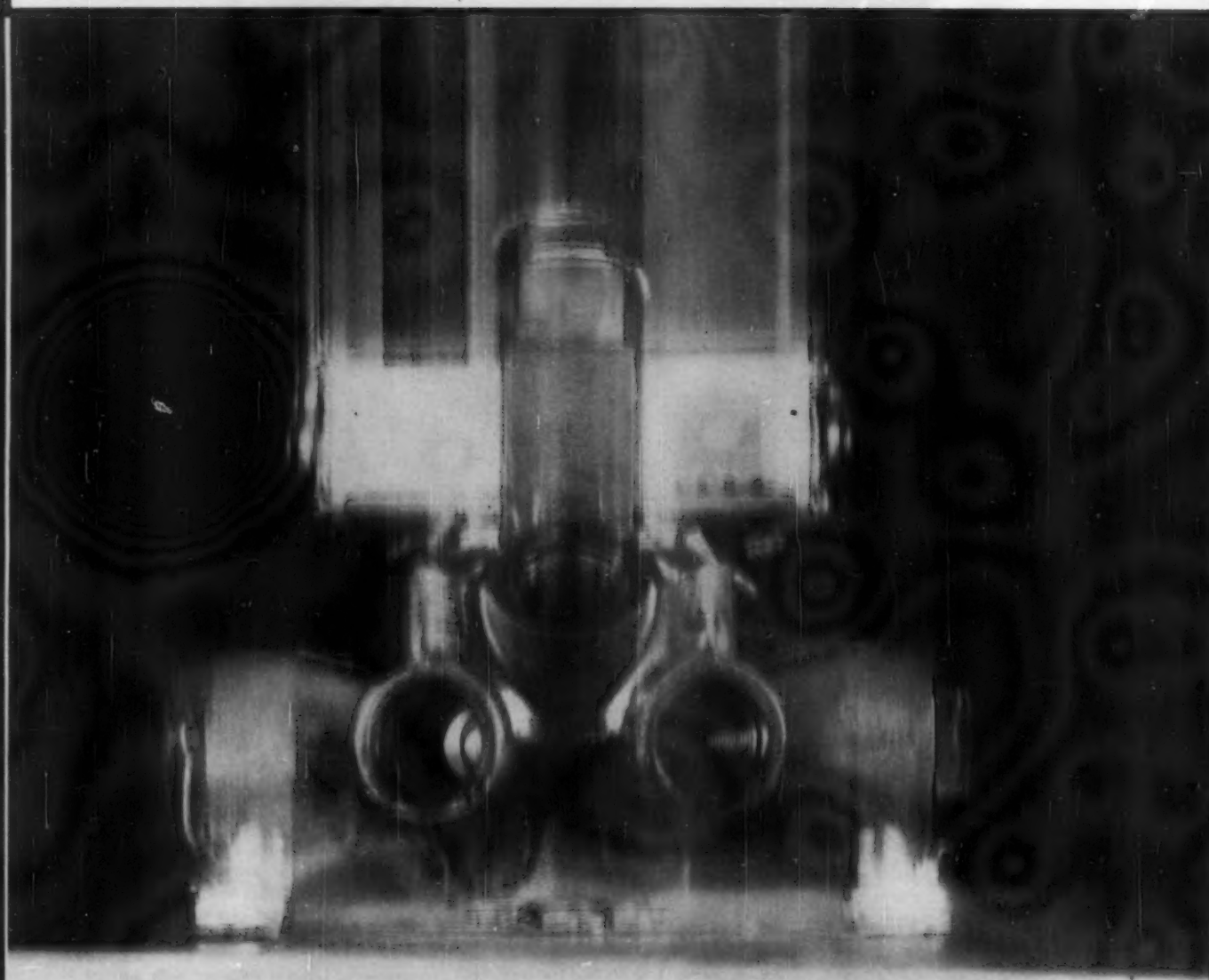

IMPACT

...12 G's, to be exact. This was one of a series of drop tests performed on a General Controls 4-way hydraulic selector valve. Tests in accordance with JAN specifications included 24 shocks of 12 G's amplitude, 10 milliseconds duration each shock.

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have saved or, still, might even revive the program for a land-based version of the Talos.

Compared to $1½ million launching system for the Talos LBS, the launcher developed by American Machine for Fairchild's Bull Goose, also a surface-to-air missile, is a model of simplicity and low cost. It is a zero length, fixed angle launcher which is raised and lowered by a removable electrical jack and it costs $1,500.

The difference, however, is not just $1,498,500, American Machine declares; it is the entire approach. This particular program, perhaps, best typifies the new position of the ground support companies and shows how savings can accrue by making them an integral part of the team at an earlier stage of development.

The Bull Goose was a program that was going to depend on austerity. Fairchild brought American Machine into the program while there was still time to make some changes in missile configuration which would result in significant savings on ground support accessories. The company gave American Machine responsibility for the entire ground support complex and with it, enough time (two years) to find the most economic approaches possible.

As with the land-based Talos, an automatic loader and launcher was considered initially. But after a fairly extensive study, American Machine decided that unitized launchers—with missiles in place but still tied into an automatic fire control system—would serve more effectively and cost less.

Missile Shelters

Shelter, often a major cost factor, was another area the company was able to investigate at some length. After rejecting a conventional concrete and cinder block affair proposed by an architectural firm as too expensive, the company turned the problem over to its own architectural group at Greenwich, Conn. The result was a somewhat unconventional but simple structure that looks like a cross between an old-fashioned breadbox and a quonset hut.

Shape of the unit plus the use of a self-supporting steel skin results in maximum inside volume. A trunnion-mounted door rolls up and back quickly for firing. Because of its simplicity, it can be mass produced and, consequently, is comparatively cheap, costing less than $3,000 each. (The first unit is now going up in Chicago, Ill., where it will undergo snow-loading and wind tests. Later it will be taken down and shipped to Cape Canaveral, Fla., for further tests.)

Another example of how time can buy money and efficiency is the Bull Goose transporter, which actually is a

combined transporter and transferer. The vehicle consists of a skeletonized, two-wheeled trailer body with a small overhead crane attached to the front end. In transport, the missile rests on two saddles which span the body fore and aft. Upon arrival at the site, the trailer backs up to the shelter and the crane transfers the missile directly to the launcher.

Brought in early enough, a ground support company, according to American Machine, can save 50% in engineering costs alone. Given a free hand, it can design on a system basis and provide the prime contractor with a minimum number of units to achieve maximum ease of handling.

In the case of the Bomarc, for example, original plans called for the missile to be launched from a modified V-2 platform in which it would simply rest on its tail prior to launching. Early tests showed that the missile was unstable in this position when winds arose. To steady it, designers proposed adding 60 lb. to the weight of the missile. But the ground support group showed them how they could save this extra weight by simply adding restraining arms to the launcher.

Eliminate Duplication

Another benefit of bringing in the ground support people early is the elimination of costly duplication of research and development equipment and operational equipment. Usual practice is for each missile contractor to rig up his own equipment for testing early research and development versions of his product. Later, this equipment is generally junked, but not before the contractor has used it as the basis of his specifications for operational ground support equipment. Both the expendable test equipment and the specifications, which in effect block the ground support equipment makers, cost programs heavily in dollars and efficiency.

Much of this waste can be eliminated, support experts declare, by asking them in early enough to propose on all equipment needed from the research and development stage on. This would enable them to develop R&D units which with little or no modifications could also serve as operational equipment. Better yet, they say, ask them in as part of the original development team and let them write the ground support requirements into the initial proposal—as was done recently on the Dyna-Soar program.

Time itself is another argument for the early entry of the ground support group. The Air Force has shown fairly conclusively that months can be cut off major missle programs by developing different parts of the weapon system concurrently.

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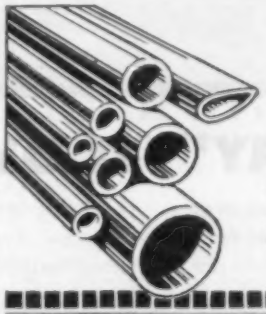

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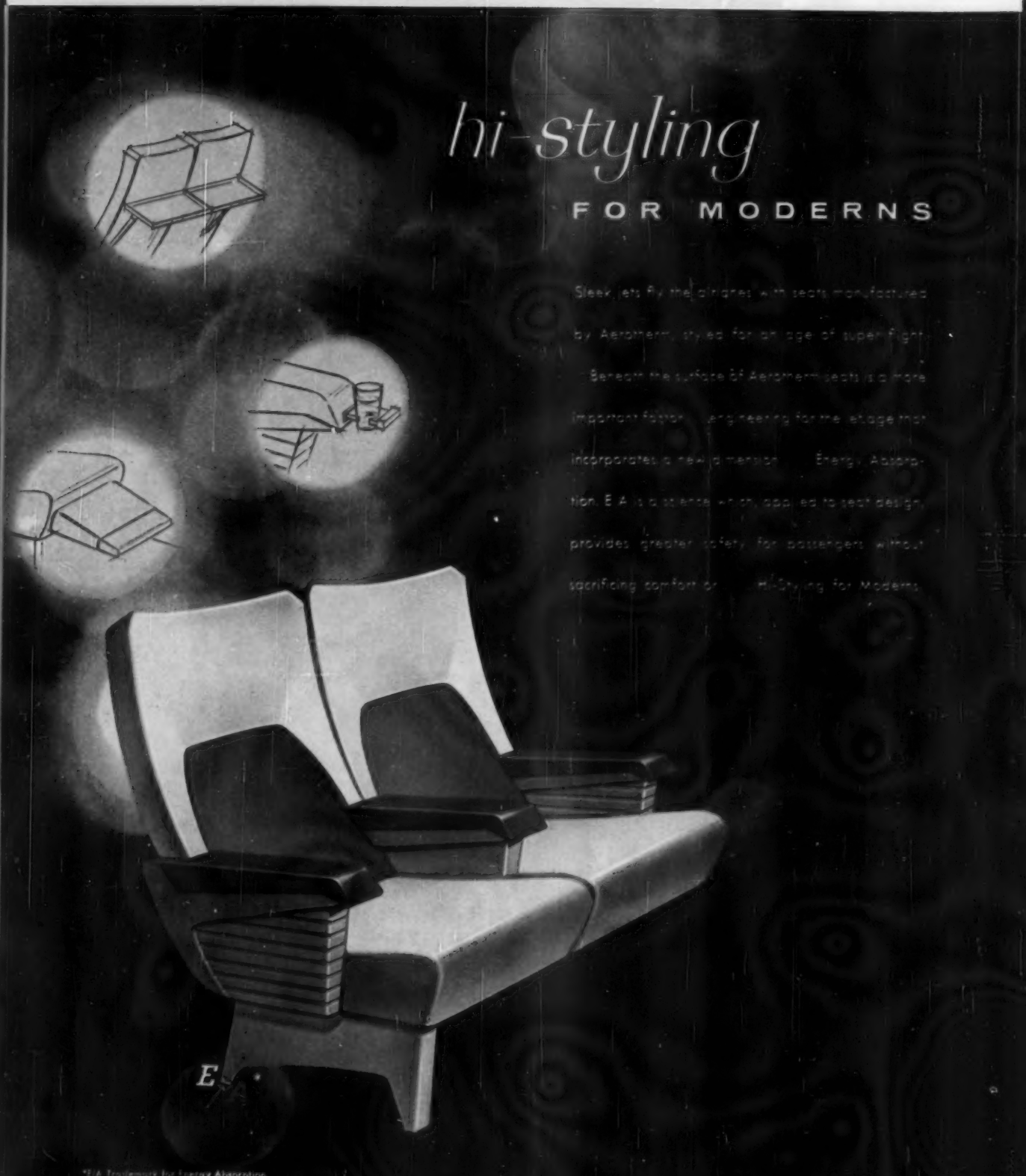
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SIKORSKY HSS-1, one of the mainstays in Task Force ALFA's attempts to improve its submarine detection capability, dunks its AQS4 sonobuoy alongside the destroyer USS Richard Anderson. Helicopters normally patrol the outer fringe of a search area, call in aircraft and destroyers for final verification and "kill" after a contact has been made. Normal hovering altitude during maneuver is 30 ft.

Navy Strives to Improve ASW Tactics

By Cecil Brownlow

With Task Force ALFA—Task Force ALFA is working to blend aircraft, destroyers, submarines and airships into an integrated, effective anti-submarine weapon.

ALFA first put to sea in April with specific instructions to improve the organization, technology, tactics, doctrine, weapons and equipment employed in anti-submarine warfare.

This special research-training Task Force was ordered into existence last fall after it had become evident that the Soviet Union had submarines equipped with air-breathing surface-to-surface missiles and after it was no longer safe to assume that Russian nuclear submarines carrying ballistic missiles would not soon follow.

Ultimate goal is to find means of detecting a Soviet submarine any and every time it takes an underwater station within missile range of key U.S. defense complexes. Final achievement of this goal, a staggering task under any conditions, cannot be gained until major breakthroughs are made in the fields of underwater detection and classification.

While awaiting these breakthroughs —and Navy is asking industry to lend an urgent hand (AW July 14, p. 32)— ALFA is attempting to develop tactics and crews to the point where best possible use will be made of the equipment available.

Its striking and detection force consists of the flagship, the Essex-class carrier USS Valley Forge, carrying a squadron of Grumann S2F search planes (VS-36) and a squadron of Sikorsky HSS-1 helicopters (HS-7); a squadron of land-based Lockheed P2V-7s based at Chincoteague, Md.; blimps that come out on a revolving basis from Airship Squadron Three at Lakehurst, N. J.; eight destroyers of Destroyer Squadron Twenty Eight, and two conventional hunter submarines, the USS Sea Leopard and the USS Cubera.

An immediate goal of this task force is to develop its capability to a point where it can not only detect a submerged Russian snorkel submarine but also keep it in constant contact for the three to four days required before it is finally forced to surface because of lack of oxygen.

Most obvious benefit of such a capability would be a tangible demonstration for the benefit of Soviet leaders that they cannot push their submarines into waters off the U.S. with the impunity they sometimes enjoy at present.

Once this capability is actively demonstrated, ALFA commander Rear Adm. John S. Thach says his task force will offer the submarine "the courtesy of the sea."

Such courtesy, Thach admits, might include an invitation for the submarine to put into Norfolk for a brief call.

"If," he explains, "the submarine came over here with a prior announcement that it was coming, or if it came on the surface, you could assume he was on a friendly mission. But when it comes unannounced and under the surface, you have to assume that maybe it's not so friendly."

In its training exercises, which often keep ALFA crews on a readiness basis approaching that of wartime, the task force already has evolved a close-knit system of teamwork that adds up to

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FIREBEE: "ENEMY" JET OVER AMERICA

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Developed by Ryan for the Air Force (Q-2A), Navy (KDA-1) and Army (XM21), the Firebee is in volume production and operational use. It is being fitted with special radar and infra-red reflective devices for simulating varied target characteristics and providing broader missile-target compatability. The Firebee can be equipped with wing pods to carry added fuel... a warhead... photo or television reconnaissance gear.

The Firebee is an example of Ryan's skill in blending advanced aerodynamic, jet propulsion and electronics knowledge to produce a highly successful solution to a complex aviation problem... meet a vital military need. Other examples are the Air Force-Ryan X-13 Vertijet and Navy-Ryan AN/APN-67 automatic navigator for global jet flight.

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what Adm. Thach terms a "brand new concept."

The pilot of an S2F or a HSS-1, for example, may be called upon to take over the tactical command of all the forces within a search area—other aircraft, destroyers and hunter submarines. Or he may work on orders stemming from the conning tower of a submarine or from the bridge of an airship.

Decision as to who takes command at any given time is made on the spot as ALFA's anti-submarine components converge upon a search area, and it can skip from one vehicle to another as the situation develops. Generally, it flows to the vehicle with the best overall picture of what is going on and/or the strongest contact with the hunted submarine.

In other exercises, an S2F may orbit above a destroyer or submerged hunter submarine while the surface and subsurface craft search for contacts with their relatively long range sonar gear—up to 25 mi. on a good day when temperature conditions of the water are constant, down to practically nothing when sharply changing temperatures block the passage of sound waves.

Search Area

Once contact has been established, the S2F flies off to search the suspect area with sonobuoys and magnetic aerial detection gear. The MAD equipment, limited in range, can establish whether the contact is metallic or whether it is some form of ocean life.

Sonar often cannot distinguish between the two.

An ALFA search area can resemble Times Square at noon: Up to eight destroyers converging on the scene in two diamond formations, an inner and outer screen; HSS-1s scurrying ahead and to the side, dunking their sonar buoys and then moving on again; S2Fs flying in low in search of a firm contact—their MAD gear trailing from the tail on booms—and then pulling up and turning to avoid destroyer masts.

The movements are complex and intertwined. "Things can get pretty tight in that area," Adm. Thach says, "and you can't give the job to amateurs."

Regulations stipulate that the helicopters should hover at an altitude of 30 ft. when dunking their sonar gear, but to take advantage of the sea cushion pilots often hover as low as 10 ft.

Standard cable length for the sonar ball is 90 ft., which means that the dunking depth is generally 60 ft. In attempts to give the helicopter better range in pushing its ball through the sound-distorting temperature "ducts," ALFA has experimented with cable lengths of up to 150 ft. The extra cable, however, adds to the helicopter's weight, a critical feature, and the time required to

New Aeroquip Strap with Ratchet Buckle

FOR AIRCRAFT CARGO CONTROL

At Lockheed Aircraft Corporation, the new Aeroquip 5000 lb. Ratchet Buckle is used to hold the forward flight section of the prop-jet Electra on a rolling platform during production stages. An easy-tensioning and quick-release buckle, it actually takes up to 4 feet of slack under introduced load, and at the same time, introduces a tension that can reach up to 500 lbs. Operates as a miniature winch . . . can be used with any length webbing. There are all kinds of manufacturing and cargo applications. Return the coupon for full information on this and other types of cargo control strap assemblies.

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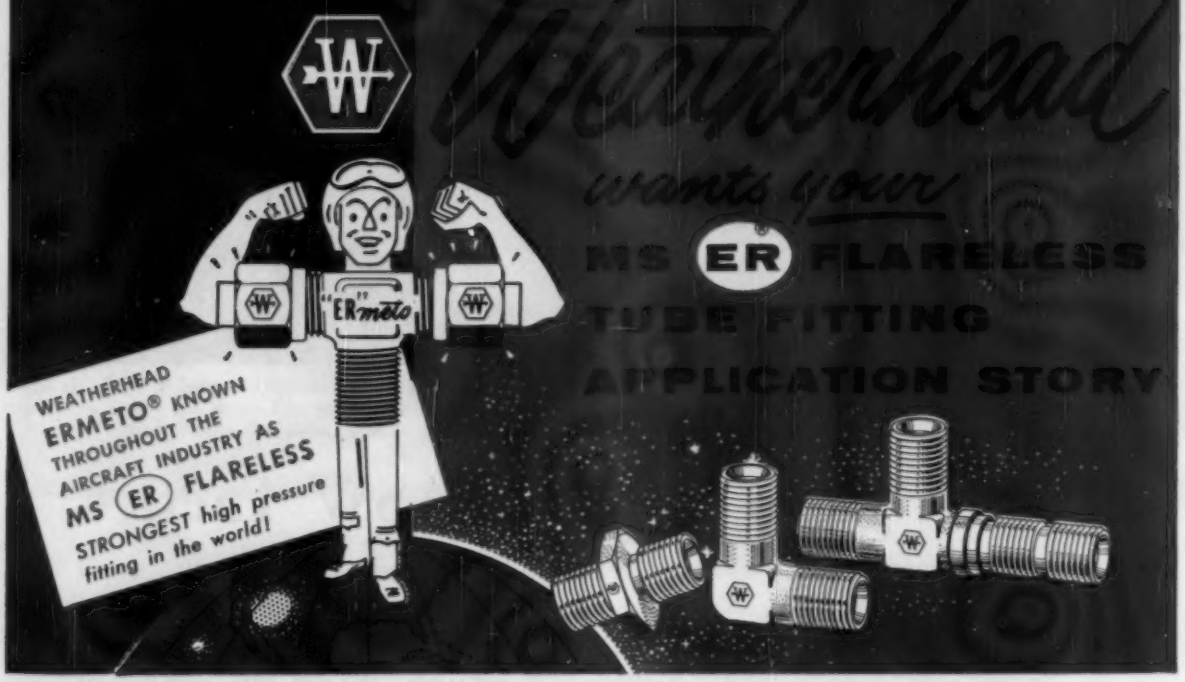

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act now . . . contest closes Sept. 30, 1958

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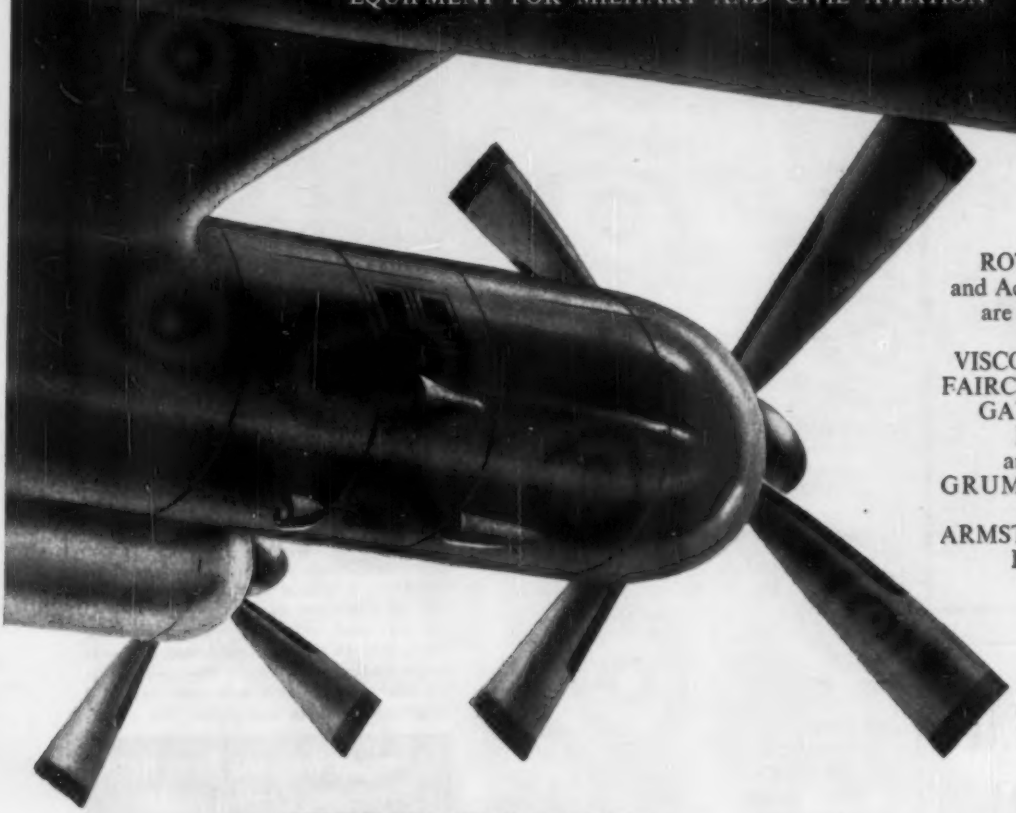

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lower the gear, make a search and move on to another area.

A helicopter sonar operator can make a 360 deg. sweep with his AQS4 gear in approximately six minutes. If contact is firmly established, the pilot, who can monitor the sonar, notifies the flag ship and other search units by radio and by turning on the flashing red Grimes Light located on the helicopter's tail. The light also avoids any confusion as to which helicopter in the area has the contact.

If no contact is made, the helicopter may stay in hover to make another sweep of the area, or it may move on to another spot before resuming its search.

Biggest task of the pilot in such an operation is to keep the sonar ball hanging vertically in the water and to prevent any dragging that would distort its signals.

The HSS-1 is equipped with an automatic hovering device, but it is often out of order, forcing pilots to carry out the hover operation manually throughout the normal helicopter search period of two and one-half hours. "Flying like that," one pilot observed, "is like six hours of regular flying." In addition, when a Russian submarine has been detected, the flying time for an ALFA helicopter pilot may run as high as seven hours a day.

Maintenance Problem

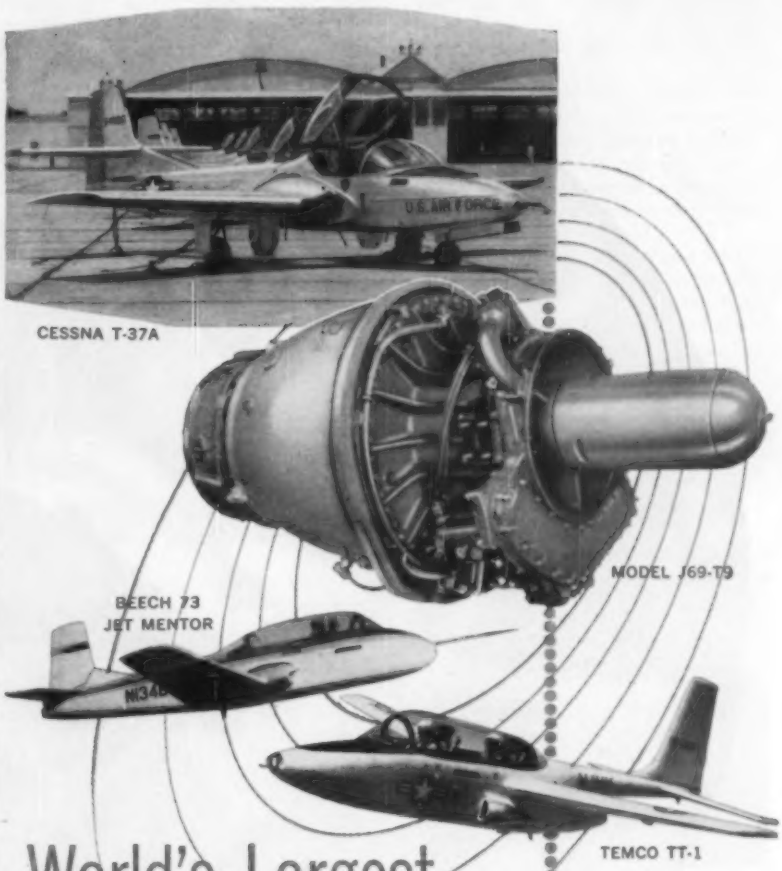
Unreliability of the hovering unit and other electronics equipment aboard the HSS and the S2F aircraft is due primarily to the inexperience of many of the enlisted technicians aboard the Valley Forge. Because of the high turnover in trained personnel, who leave the service for higher paying civilian jobs, much of the maintenance must be conducted by youngsters just out of electronics school.

"Our good men," a maintenance officer complains, "either leave us, or we have to put them in supervisory positions."

In time of war, the HSS-1 could be deployed to kill as well as to serve as a search weapon. It is equipped to carry two Mk. 43 homing torpedoes, one on either side of its fuselage.

To launch his weapons, the helicopter pilot usually fires from a shallow dive at a speed of approximately 50 kt. Each torpedo, however, weighs about 200 lb. and cuts deeply into the fuel supply the helicopter can carry. For this reason, they are seldom carried on long-range search missions.

The S2F, sister aircraft of the HSS-1 aboard the Valley Forge, normally remains airborne on search missions for four and one-half hours before being relieved on station. Carrying MAD gear, a total of 16 sonar buoys—eight in the aft end of each engine nacelle—radar



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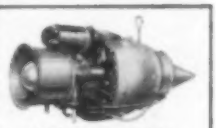
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and weapons, one S2F takes the place of two of its Grumman TBF predecessors in a hunter-killer group. Formerly, two TBFs operated as a single unit, one carrying the search gear, the other the weapons.

Within its relatively small frame, the S2F carries practically the same search gear as the P2V, although the range of the land based aircraft's radar is somewhat greater. Average cruising speed during search missions is 145 kt.

The aircraft also is equipped with smoke bombs that are fired to the rear from the belly of the aircraft by compressed air at the same speed the S2F is flying. This cancels out the inertial effects of the aircraft speed and permits the crew to exactly mark the location of a MAD contact by firing a smoke bomb the instant the contact is received.

The bomb helps the pilot in orienting himself for a second pass over the suspect area and, once a pattern has been established, aids both aircraft and surface vessels in determining just what the submarine is doing—remaining in the same position, describing figure 8s in the water in an effort to create "knuckles" in the water which a sonar operator might mistake as the submarine itself, or making a fast dash for safety.

The S2F is generally popular with the pilots who fly it, particularly its handling characteristics, although some complain mildly that the automatic rudder trimmer makes it too easy to over-correct when making a carrier approach. Adm. Thach calls it the "best ASW airplane I've seen."

However, in line with his demand that both fixed and rotary-wing aircraft be given greater lift capability, Thach contends that he "can't put all the things into an S2F that I want to put into it."

The Admiral also would like anti-submarine aircraft of the future to have a dash capability similar to that planned for Army's higher observation plane. Such a capability would allow the aircraft to rush from the carrier to a suspect area at a relatively high speed and then "loiter" there for long periods while making its search.

Both aviation and deck officers attached to ALFA agree that their detection capabilities have been markedly improved by the experience they have received since going to sea with ALFA in April. A submarine commander said recently:

"When we first came out, the S2Fs had difficulty in finding us even when we wanted them to. Now, they can find us, and sometimes they can hold us."

All in all, with more training and teamwork, ALFA probably will become the most dangerous anti-submarine weapon the U. S. or any other nation has ever possessed. But human effectiveness and tactics cannot erase the need for effective, reliable electronics gear for positive detection and classification. Until these are found, the submerged submarine will keep its decided advantage over its opponent.

T-33 to be Adapted To Re-Entry Study

Lockheed T-33 test airplane that can simulate dynamic characteristics of manned space vehicles during re-entry will be used by Cornell Aeronautical Laboratory, Inc., under a new $200,000 contract with USAF.

Contract calls for study of the problems of flight control for manned space aircraft during and after entry into the atmosphere.

Variable stability and control T-33 (AW Aug. 12, 1957, p. 63) will be specially modified in the attempt to determine whether a pilot can safely fly a space vehicle whose handling characteristics are expected to differ greatly from those of present aircraft.

Performance of both pilot and vehicle will be evaluated. Various dynamic configurations of aircraft and different types of entry will be simulated. Contract is sponsored by Air Research & Development Command.

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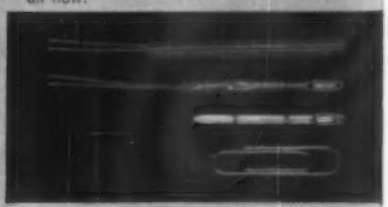

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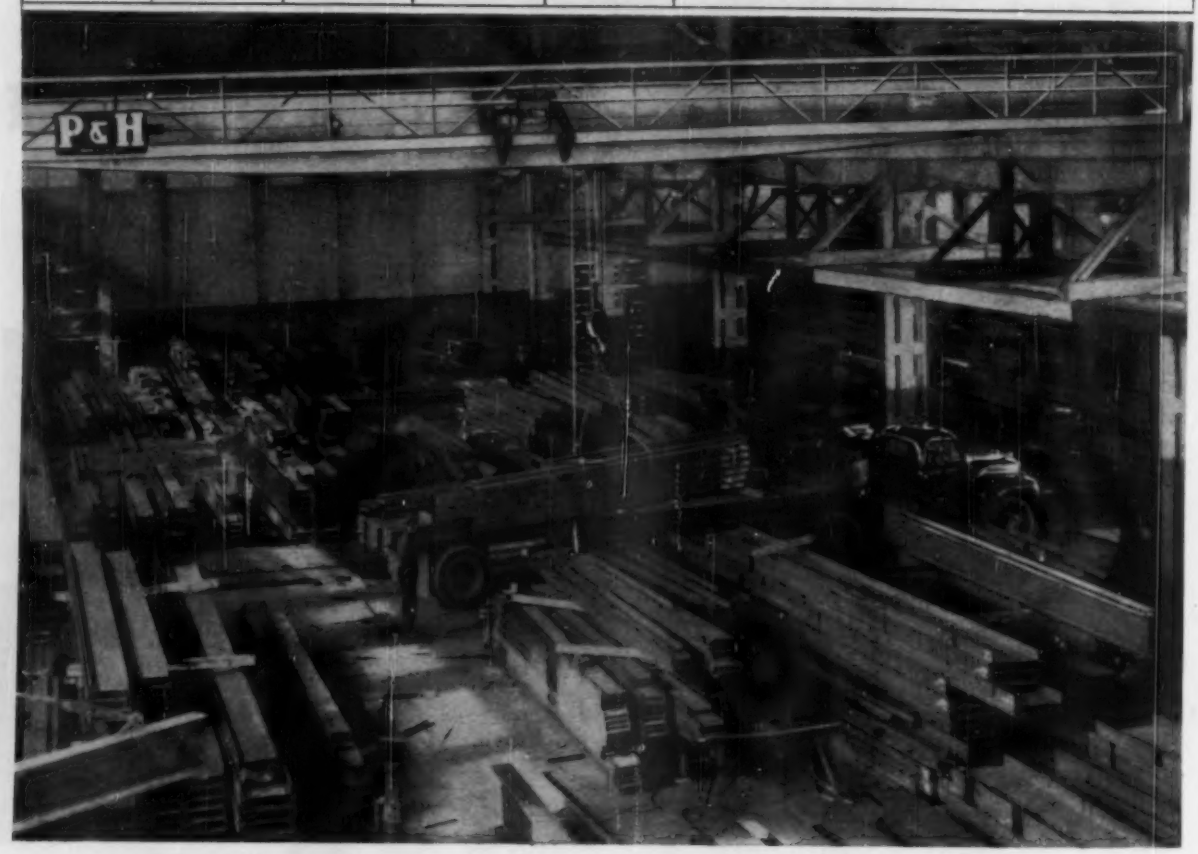

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NEW AVIATION PRODUCTS

Autopilot Heading Computer

ANC-2 computer utilizes standard inputs from omni receiver and stabilized magnetic heading to furnish continuous control signal to yaw axis of autopilot for automatic enroute navigation.

Computer permits automatic tracking on VOR radial or will provide steering signals to lock autopilot to a pre-selected magnetic heading. Total weight of unit is 4 lb.; power drain is negligible, the maker states.

Dynavia Engineering Corp., 860 Fabian Way, Palo Alto, Calif.

Missile Motor

Model C-2610 missile motor is presently being used by two missile manufacturers in classified applications, the maker states. Operating on 400 cycle, 3 ph-208 volt current, motor produces 1 hp at 22,000 rpm. Motor weighs 2 lb. 12 oz. and measures 2½ in. dia. by 4 in.

Hoover Electric Co., 2001 So. Stoner Ave., Los Angeles, Calif.

Radioactive Exit Markers

Emergency exit marker for aircraft utilizes radioactive tritium gas, eliminating need for electrical power. Design utilizes phosphor-tritium gas combination to obtain illumination of suitable legends.

Construction is said to minimize leakage; however, the manufacturer states that if unit is ruptured, gas is rapidly dissipated into the atmosphere.

United States Radium Corp., Morristown, N. J.

Linear Instrument Bearing

Ball bushing developed for accelerometer in inertial guidance system has application in instruments, controls and other components requiring low friction linear motion. Maker says bushing can be made to roll down a shaft inclined at an angle of 1 min. or less.

Details regarding near-zero friction level are restricted.

Inst-4812 ball bushing has a ball retainer milled from a solid sleeve for greater strength. Passages between ball retainer and outer case permit cleaning solvents to be blown through. Dimensions are: bore dia. .2500 in. +.0000 or −.0003, nominal outside dia. .5000 in.,

length .750 in., weight .02 lb., rolling load rating 13 lb., static load rating 22 lb.

Outer sleeve and balls are usually made of AISI 52100 steel and the retainer of brass. Bearings can be furnished made entirely of stainless steel when required.

Thomson Industries, Inc., Manhasset, N. Y.

Hot Air Regulating Valve

Hot air regulating and shutoff valve is designed for aircraft. Valve is used in the Douglas A3D-2P photographic version of Navy attack aircraft.

Valve withstands temperatures of 825F, pressures up to 250 psig. and flow rates to 3 lb. per min., the maker states.

Randall Engineering Corp., 5933 Bowcroft St., Los Angeles, Calif.

High Temperature Test Oven

High temperature chamber tests hydraulic actuators used in guided missile systems. Oven test cycle includes elevating temperature at a fixed rate and decreasing temperature at an accelerated rate. Six finned-pipe cold water cooling elements provide quick temperature drop.

Chamber can maintain continuous temperature of 650F with its 60 kw heat input capacity. Neutral atmos-

Cargo Belt Loader

Air cargo belt loader can move a distributed load of 1,000 lb. on its 2 ft. wide conveyor belt. Mounted on a Jeep chassis, loader is more maneuverable than other loaders, manufacturer states.

Loading belt is powered by a Vickers vane type pump which is belt driven from the Jeep crankshaft. Conveyor is raised or lowered from the driver's seat; belt speed and direction may be controlled by operator in aircraft or on ground. Belt is 20 ft. long, has maximum loading height of 11 ft., and minimum height of 5 ft. at the front. Outboard rail may be folded down to accommodate packages wider than 2 ft. 10 in.

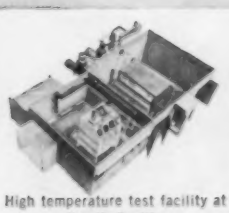
Willy's Motors, Inc., Toledo 1, Ohio.

HOT AS HELL

. . . and tough to survive in.

Building this kind of toughness into hydraulic, electronic, and electro-mechanical equipment is part of the job presently going on at Bendix-Pacific. High temperature environmental facilities provide operating conditions up to 1200°F for the evaluation of components and systems. These facilities played a key role in the successful development of the Bendix-Pacific hydraulic flight control system components for the B-58 and in the solution of the heat transfer and dissipation problem in the ATLAS telemetry system.

The high temperature problem area is one of many in which Bendix-Pacific is helping to advance the frontiers of airborne equipment performance.



High temperature test facility at Bendix Pacific

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Bendix Pacific
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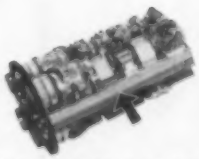

Bendix designed heat sink in the Atlas telemeter

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HOT AS HELL

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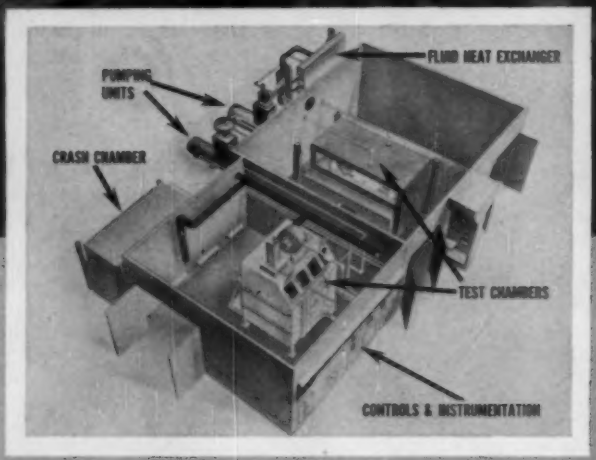

800°F HYDRAULIC FLUID TEMPERATURE

–100°F TO +1200°F AMBIENT TEMPERATURES

This is the present temperature test range available at Bendix-Pacific in its development work on servo valves and standard hydraulic components.

The High Temperature Test Facility at Bendix-Pacific is a self-contained department where all data is obtainable for complete qualification of products. The facility is equipped with unusual safety precautions. Pressures up to 5000 psi and flows to 37 gpm can be maintained. The facility can handle fluid temperatures to 800°F when the fluids become available.

Such engineering facilities assure complete development of Bendix-Pacific hydraulic products from design concept through final qualification.

Bendix
PACIFIC DIVISION
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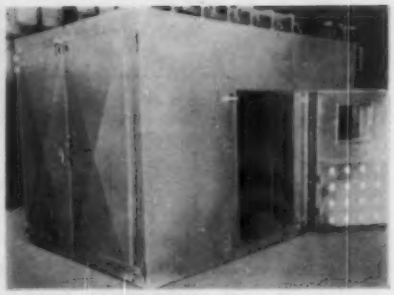


phere of nitrogen gas is maintained when chamber's temperature is above room ambient. Heating element, controls and motors are explosion proof. Steel unit measures 5 ft. wide by 8 ft. deep by 6 ft. high.

Grieve-Hendry Co., Inc., 1401 W. Carroll Ave., Chicago 7, Ill.

Navy Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by U.S. Navy contracting offices:

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia, Pa.

A. M. Byers Co., Pittsburgh, Pa., steel, bars, alloy, hot-rolled, N383-53426A(IFB-383-799-58), 199,530 lbs., $25,490.

Utica Division, Bendix Aviation Corp., Utica, N. Y., spare parts, required to support eclipse starters, N383-52617A(383/2118-27306 P6/2/55 Aero.), $30,495.

George Senn, Inc., Philadelphia, Pa., compound, grease cleaning, solvent emulsion type, N383-52855A(IFB-383-668-58), $61,898.

Starlite Manufacturing Co., Gradena, Calif., chock, wheel, adjustable, N383-52974A(JD-IFB-383-648-58), 2,973 ea., $37,014.

Jebco, Inc., Jonesboro, Ga., metal drums, N383-52963A(IFB-383-724-58), $81,639.

Bell Helicopter Corp., Fort Worth, Texas, spare parts for helicopters, N383-51624A (383/9011-210577 A5/2/58 Aero.), $39,533.

The New York Brake Co., Watertown, N. Y., pump assemblies, required for use on 571-2 engines, N383-52635A(383/26126-27391 P6/2/56), 91 ea., $50,593.

Space Corp., Dallas, Texas, test beds for jet engines, N383-(127)52491A(127/9500-P-20086-58), $38,740.

Elsin Electronics Corp., Brooklyn, N. Y., radio test beds, N383-(24)53352A(JD-IFB-383-633-58), $209,264.

Gould-National Batteries, Inc., Depew, N. Y., aeronautic storage batteries, N383-53398A(IFB-383-633-58), $151,263.

Transco Products, Inc., Los Angeles, Calif., coaxial switches, N383-53511A(IFB-383-795-58), $57,360.

The Cleveland Pneumatic Tool Co. Division, Cleveland Pneumatic Industries, Inc., Cleveland, Ohio, maintenance parts for actuators on various aircraft, N383-52858A (383/6112-29471/56) $43,425.

Mine Safety Appliances Co., Pittsburgh, Pa., spares for APH-5 helmets, pilot protective, N383-52701A(IFB-383-658-58), $276,803.

The Roflan Co., Topsfield, Mass., spares for APH-5 helmets, pilots protective, N383-52702A(IFB-383-658-58), 38,289 ea., $55,136.

A. Schrader's Son Division, Scovill Manufacturing Co., Inc., Brooklyn, N. Y., gaging devices, shock strut and accumulators, N383-53101A(IFB-383-658-58), 1,951 ea., $31,704.

Christie Electric Corp., Los Angeles, Calif., converters, constant voltage, N383-52914A(383/9065-21838-E4/3/58), $187,187.

Federal Aircraft Works, Inc., Minneapolis, Minn., services and material to install Teflon on ski bottoms, N383-52887A(383/3055-210297 A4/1/58), $54,657.

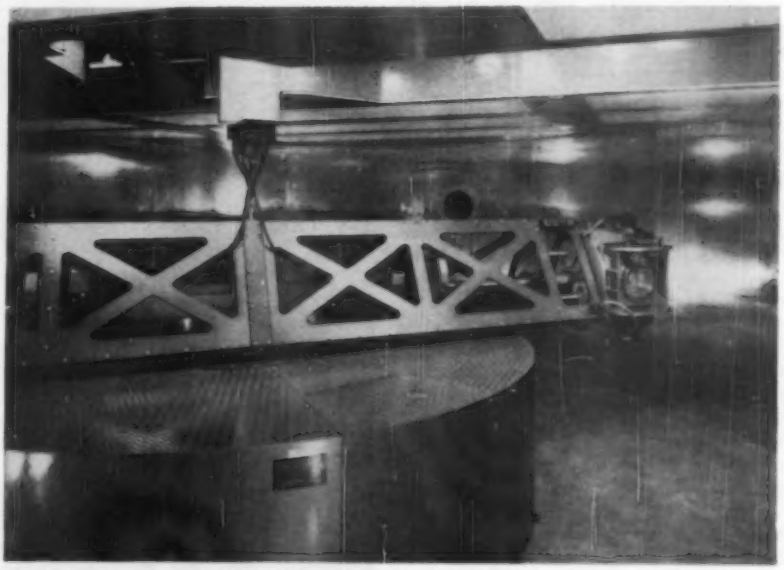
Centrifuge Tests Components for Titan

Precision centrifuge, developed to calibrate accelerometers in the Titan intercontinental ballistic missile guidance system, is accurate to one part in 100,000 of centrifugal force—roughly two orders of magnitude more accurate than previous centrifuges, the builder claims.

Design and construction of the 20 ft. diameter machine was carried out by Genisco, Inc., Los Angeles, for American Bosch Arma Corp., Garden City, N. Y., Titan guidance contractor.

Originally Arma ordered two precision centrifuges at $150,000 each. However, a stretchout in the Titan guidance program necessitated cancellation of the second unit.

Genisco found a buyer for the second centrifuge in AC Spark Plug, Thor intermediate range ballistic missile guidance contractor.



PRECISION or "bird cage" end of centrifuge arm has special mounting for testing Titan ICBM guidance accelerometers at from 1 to 10Gs. Length of the 100 in. radius arm is controlled to 100-millionth of an inch by means of 72F air-conditioning.

Force Measurement

Arma B-1 VS accelerometer, used in the Titan guidance system (AW May 12, p. 92), is capable of measuring acceleration forces as low as .000005G. This degree of accuracy is not feasible in large rotating machinery. Therefore the practice of using test equipment of greater accuracy than the components to be calibrated had to be discarded, and the target performance specification of one part in 100,000 of centrifugal force was established.

In meeting this specification, Genisco says it has developed the first piece of test equipment capable of calibrating inertial guidance components to accuracies necessary for reliable prediction of ballistic and satellite trajectories.

Centrifugal force varies directly with radius and as the square of the angular velocity or speed of rotation. If target specification of one part in 100,000 is divided arbitrarily between radius of gyration and angular velocity, radius must be known even under dynamic conditions to one part in 200,000 (or .0005 in. in 100 in.), and speed must be constant to within one part in 400,000.

Five factors are predominant in measuring and controlling the radius to desired accuracy:

- **Establishing and maintaining** a precise axis of rotation.
- **Measuring static radius** from the principal axis of rotation to the center of gravity of accelerometer's seismic element.
- **Temperature variation** compensation in radius of rotating arm.
- **Strain elongation** compensation in rotating arm.
- **Measuring change** in radius under dynamic conditions to verify that no appreciable change in radius has occurred, or to establish a new operating radius for each calibration check point.

Cumulative error of above factors must be held to .0005 in. Best available anti-friction bearings would eat up most of this tolerance while exhibiting excessive mechanical noise. Therefore a fluid-pressure, self-centering bearing was designed, consisting of a conical hardened and ground portion of the shaft babbitted into the main bearing post assembly. Oil pressure lifts the rotating portion of the machine and a fixed volume of oil flow controls the thickness of the oil film to about .0001 in. Dynamic measurements of bearing runout made by Arma were found to be about .000003 in.

Stable Axis

To establish a spatially stable axis of rotation, Genisco chose to achieve a close static and dynamic balance rather than attempt to design a perfectly rigid structure. Centrifuge is mounted on three leaf springs, and a force detector under one leg detects vertical motion on two paralleled null-balancing indicators—one mounted on the console, the other within the machine enclosure. Indicators are used to establish a static and dynamic balance by means of motorized weight-shifting mechanisms built into the rotating arm. If the machine is not moving about on its mounts more than .00001 in., axis of rotation is assumed stable.

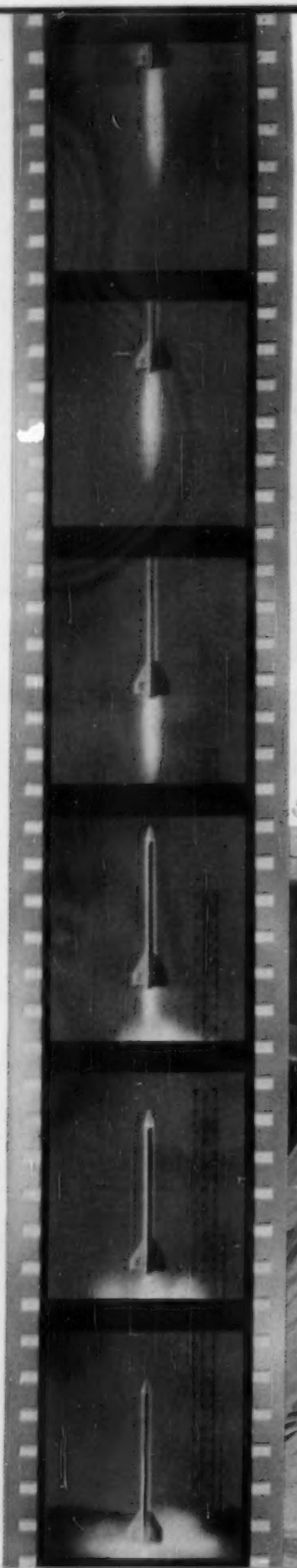
Physical configuration of the rotating arm is designed to minimize strain elongation of the "precision end." Virtually all change in radius appears at "environmental" or non-precision end of rotating arm.

Static Radius

Static radius is measured by an internal micrometer device composed of two quartz rods and a dial indicating gap-measuring device. Inner quartz rod contacts a known reference diameter of main shaft while outer end of second rod contacts another known diameter at precision end of rotor arm. Gap between two rods is then compared against a Johanssen gage block gap by the dial indicator.

Radius is then the sum of known inner radius, plus length of the two rods (calibrated by Bureau of Standards), plus known outer radius, plus measured gap. Genisco says cumulative error including temperature, tolerances, and repeatability is within a few thousandths of an inch.

Verification of radius or measurement of radius change under dynamic conditions is achieved by a micrometer



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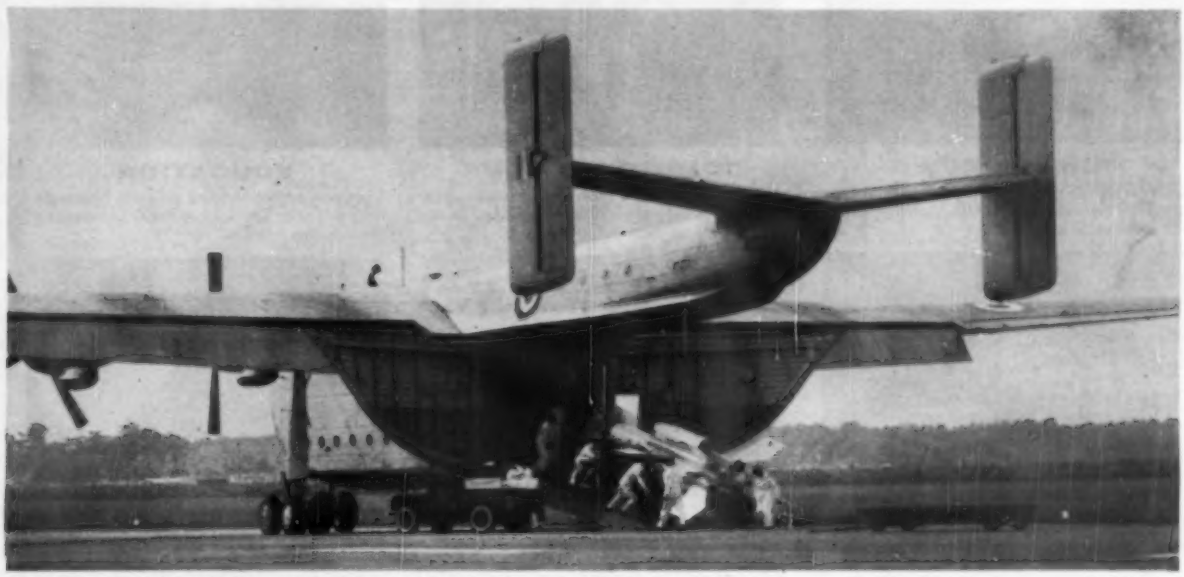
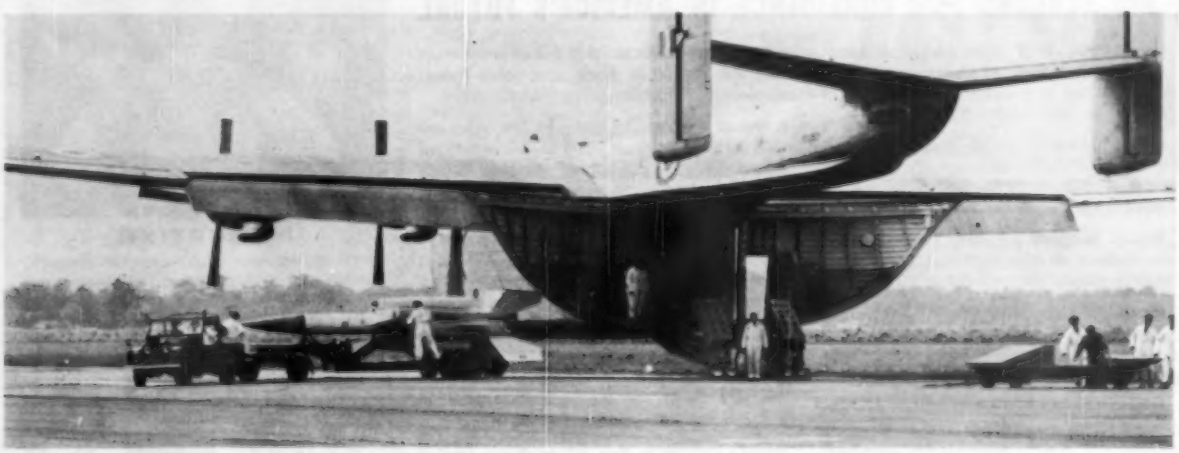
Air freighter performance was sharply contrasted by Lockheed C-130 Hercules (above), and Blackburn Beverely (below), which is unloading Bloodhound missile. C-130 delivered 85 Belgian infantrymen after shortfield takeoff and landing.



Bristol Bloodhound missile is manhandled down Beverley's ramp by 15 straining technicians who flew in with the weapon. Bloodhound (below) is hauled away on a flat trailer fitted with special ramp sections. Unloading and setup routine took about 15 min.



device called a dynamic radius comparator.

Wand projecting from the precision end extends to within a fraction of an inch of inside surface of cylindrical enclosure of machine and brushes past an electrical pickup mounted on an Invar rod. Radius of rod is positioned from outside enclosure by a micrometer head supported from main foundation monolith. Device has proved to be repeatable by various operators to within one ten-thousandths of an inch.

Angular Velocity

Major obstacle in designing the centrifuge proved to be the maintenance of a constant angular velocity. Investigation showed that a combination of three conditions was mandatory:

- **To minimize turbulence** and resulting rotational irregularities, machine must be enclosed in a cylinder presenting aerodynamically clean windage characteristics.
- **Drive must be coupled** to main shaft of centrifuge. Gears, belts or other speed reducers would produce intolerable variations.
- **Motor must be synchronous** and must be supplied from a stable, precision, variable-frequency power source.

Motor is an eight-pole, three-phase induction start configuration whose rotor is carried on the main shaft and whose stator is mounted on the main bearing post. Required machine speed control from 6 to 105 rpm. necessitated a three-phase power supply infinitely variable from .4 to 7 cps., and torque demands placed maximum current at 200 amp. Final amplification is done through three electromechanical rotary amplifiers.

Electronic Counter

Speed indications are provided by an aircraft tachometer to 1% accuracy; a 600 pulse per revolution pickoff, for accuracies to 0.1%, and for accuracies up to one part per million, by means of an electronic counter which measures elapsed time per revolution (or multiples of revolutions).

Instrument payload at the precision end is 50 lb., measuring 16 in. cube. Centrifuge can exert up to 25Gs on a 300 lb., 36 in. cube package at the environmental end.

Yugoslavia to Evaluate Folland Gnat Fighters

Yugoslavia has ordered two Gnat Mk.1 light jet fighters with spares and ground equipment from Folland Aircraft Ltd.

Aircraft will be used for evaluation trials by Yugoslav Air Force. Folland is producing 25 Gnat Mk.1s for India and 12 for Finland.

Belgian Air Force fighter team breaks right and left into an opening fan formation.

Netherlands Showcases NATO Airpower

Royal Netherlands Air Force air show at Soesterberg, Netherlands, provided a striking showcase for NATO airpower, with U.S. Air Force operational units making most ambitious performance. Typical maneuver was low pass by USAF Skyblazer jet acrobatic team in North American F-100 Supersabres (below). Their dense smoke often nearly obliterated aerial flight tactics. First prize for acrobatic team went to Italy's 6th Air Brigade Red Devils, flying Republic F-84F Thunderstreaks (AW July 14, p. 31). USAF and Royal Air Force teams did not enter competition since they are not regarded as professionals. Air show keynoted celebration of Netherlands Air Force 45th anniversary. Simulated weapons demonstration by Netherlands Thunderstreaks was successful, with 12-plane team destroying target on first pass, using inert napalm containers. Bristol Bloodhound missile unloading and setup was demonstrated after Bloodhound was flown in by Blackburn Beverley freighter. Routine took 15 min. to place weapon in firing position, which observers noted was far removed from necessary field routine to set up a battery with associated equipment and logistics lines.

USAF Skyblazer jet acrobatic team trails dense smoke as it streaks past reviewing stand.

SAFETY

CAB Accident Investigation Report:

Turbulence, Pilot Control Action Blamed in P-38 Photoplane Crash

At 1303,[1] August 23, 1957, a P-38L, N 69902, crashed about 1¼ miles south of the Greater Pittsburgh Airport, Pittsburgh, Pa. The aircraft, owned and operated by Hycon Aerial Surveys, was totally destroyed as a result of the crash and ensuing fire. The two occupants, a pilot and photographer, died in the crash.

HISTORY OF THE FLIGHT

N 69902 departed Tulsa, Okla., about 1030 on August 23, 1957, for the Greater Pittsburgh Airport. The crew of the aircraft consisted of Gilbert Mendoza, pilot, and John L. McPherson, photographer.

The flight proceeded normally on a VFR flight until nearing Greater Pittsburgh Airport. About 15 mi. southwest of the field, radio communication was established between N 69902 and the Pittsburgh tower; the pilot was given landing information, which he acknowledged.

TWA Flight 160, a Constellation N 91205, en route from Dayton, Ohio, to Pittsburgh, Pa., approached the Greater Pittsburgh Airport from the southwest at approximately the same time as the P-38. When the Constellation was in sight of the tower, the captain was given his landing sequence. At this time the P-38 had not been sighted by the controller.

A short interval later the controller saw both aircraft. It appeared to him that the P-38 was approaching the Constellation from behind and on the same approximate heading.

He immediately issued a series of radio calls to determine if the P-38 pilot had the Constellation in sight and to inform him of his landing sequence. Pilot Mendoza acknowledged these calls but his aircraft continued to close on the Constellation.

Very shortly thereafter the TWA Constellation was observed to alter course radically in a climbing right turn. The P-38 was next seen in a vertical left bank, after which it nosed down and dived straight to the ground, exploding on contact.

The weather reported at Greater Pittsburgh Airport at 1300, three minutes before the accident, was: Ceiling 4,000, broken; visibility 10 mi.; surface wind south-southwest at nine miles per hour.

INVESTIGATION

Pilot Mendoza and his photographer departed Ontario, Calif., on August 21, for the purpose of conducting high altitude aerial photography in several areas in eastern United States. The flight proceeded to Tulsa, Okla., where it remained for two nights. On August 23, the aircraft left Tulsa on a VFR flight bound for Pittsburgh.

As he neared Pittsburgh, Pilot Mendoza called the Greater Pittsburgh tower on a radio frequency of 126.18 mcs. The tower controller stated that he had a little difficulty in establishing communication with the P-38. He said that 126.18 mcs. is a frequency normally used by military aircraft and because it is unusual for civil aircraft to use that frequency he did not immediately identify it. However, the controller was able to establish contact with the P-38 quickly by transmitting on several frequencies simultaneously.

When communication was established, the P-38 pilot reported his position as about 15 mi. southwest at 4,000 ft. descending, and asked for landing instructions. The controller advised him to report entering downwind leg, landing runway two three, wind southwest at one zero. Receipt of this transmission was acknowledged. Somewhat later Pilot Mendoza asked if he was cleared for a left- or right-hand pattern. The controller told him traffic was left hand.

Shortly after this latter conversation between the tower and the P-38, TWA Flight 160 called the Pittsburgh tower and reported its position as over Imperial (a small community approximately three miles southwest of the airport). Six other flights in the vicinity were being controlled by the tower at this time. The controller called Flight 160 saying he had it in sight and that it was number two to land following a TWA Martin east of the field on a base leg for runway two three.

Immediately thereafter the controller saw the P-38. He said that the P-38 appeared to be about 1½ to 2 mi. behind and slightly above the Constellation, and seemed to be closing rapidly on it. To determine if the P-38 pilot had the TWA Constellation in sight, the controller initiated a call: "Nine zero two, nine zero two, do you have the Trans World Connie in sight directly in front of you and a little lower?" The P-38 pilot did not understand the call and asked Pittsburgh tower to "say again." The controller then repeated, "Do you have the Constellation in sight off your left front?" Pilot Mendoza's reply to this query was broken by another aircraft transmission. Once again the controller said, "Nine zero two pick up that Constellation, you're number three to land runway two three, follow him in." This final transmission was acknowledged by Mendoza, "Uh, roger, understand."

Immediately following this transmission the controller saw the Constellation take evasive action by climbing to the right out of the path of the P-38. Almost instantaneously thereafter he observed the P-38 in a vertical dive below the Constellation. He

[1]All times herein are eastern daylight and are based on the 24-hr. clock; altitudes are mean sea level.

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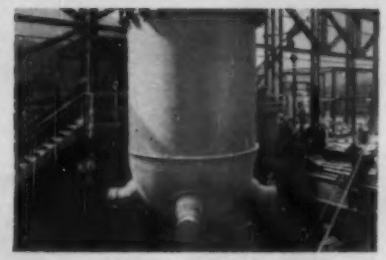

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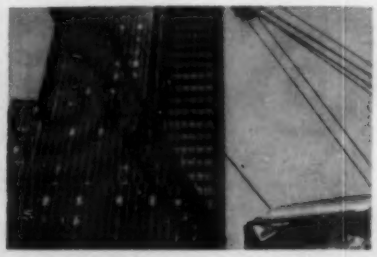

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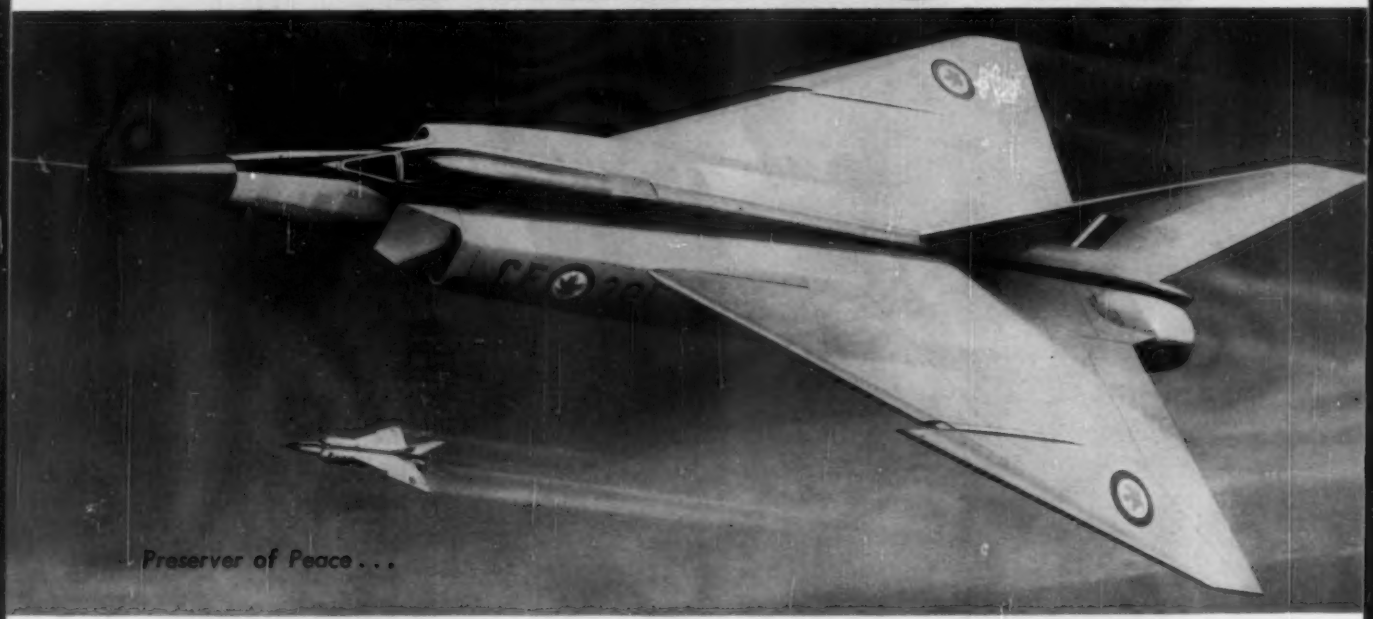

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CAMDEN, N. J.

stated that he was not conscious of the action by the P-38, which resulted in the vertical dive, as his attention had been concentrated on the Constellation. The testimony of other CAA personnel in the tower was substantially the same as that of the controller.

The captain of the Constellation described his approach to the Greater Pittsburgh Airport. He said they canceled their IFR flight plan three minutes east of Wheeling, West Virginia. Flight 160 then descended to pattern altitude (2,600 ft.) and when about 10 mi. south of the airport informed Pittsburgh tower of its position. The tower controller advised them of the active runway and to report passing Imperial. The first officer, who was flying the aircraft from the right seat, had reduced airspeed to about 150 kts. with flaps in the takeoff position. When the aircraft passed Imperial the captain, who was performing the duties of copilot, reported to the tower. The controller cleared Flight 160 to follow a TWA Martin which was east of the field on a base leg for runway 23. The crew had the Martin in sight and planned their approach to follow it in at a normal interval.

Collision Course

In scanning the area for other aircraft the captain looked to the left and saw a black twin-engine airplane at an eight o'clock position to them. The airplane was at the same altitude on a collision course converging at a 45-deg. angle. The captain immediately took over the controls of the airplane and executed a climbing right turn. He stated that he was unable to see the P-38 after starting the evasive maneuver and that he did not see any evasive action on its part.

One passenger, seated in the rearmost seat on the left of the Constellation, also saw the P-38. He said it appeared to be coming directly at them from an eight o'clock position. The witness said the aircraft appeared to be in a slight left bank and that he lost sight of it as the Constellation turned. He estimated the P-38 was about a city block away when it disappeared behind the tail of the Constellation. He also did not see it take any evasive action. He further added that he felt a collision was avoided only because of the alertness and immediate action taken by the crew of the Constellation.

Several ground witnesses saw the near collision. Most stated their attention was primarily concentrated on the maneuver by the Constellation and consequently they could not describe the maneuvers of the P-38 with any degree of accuracy. One witness, who was located in a hangar on the south side of the airport, stated he did not see the Constellation but did see the P-38 in its final dive. He said when the P-38 first came into his view it was nosed down slightly, then the dive steepened rapidly until it was vertical. He was not able to determine if the airplane was banked in any way; however, he said when the airplane was vertical it made a half turn but did not spin. He added that he saw no separation of parts and no fire prior to impact with the ground.

Examination of the Constellation immediately after landing proved that no contact between the two aircraft had occurred.

Examination of the P-38 wreckage revealed that the aircraft struck the ground on a northwesterly heading of 350 deg. In its descent the P-38 passed nearly vertically through trees approximately 60 ft. high. The resulting fire consumed a major portion of the aircraft; however, it was possible to determine that the aircraft was intact when it hit the ground. Continuity of the controls was traced and nothing was found which would have prevented their normal operation prior to impact. The wing flaps and landing gear were in the retracted position.

Both engines were broken open and burned. No indication was found which would have prevented normal operation of either prior to impact. In addition, inspection of the propellers showed both were rotating and in the cruise range at the time of striking the ground.

It was determined that no inflight fire had occurred and there was no indication of any malfunction or failure of any components or systems prior to impact.

The P-38 was a military aircraft which had been extensively modified for use in aerial photography. In 1954, the nose section had been extended approximately 42 in. to accommodate an additional crew member-photographer and his equipment. It was test flown and an airworthiness certificate was issued by the CAA which restricted it from being used to carry passengers or cargo for hire. Pilot Mendoza had flown N 69902 prior to departure from Ontario, Calif. The purpose of the flight was to check the performance of the airplane following a 100-hr. inspection, during which considerable routine maintenance was accomplished. The flight was satisfactory.

That a midair collision was narrowly averted by the TWA crew is considered indisputable by the Board. Further, the Board believes that the TWA crew should be highly commended for their alertness and prompt action which prevented the occurrence of an even more tragic accident.

Although the tower had some difficulty in initially establishing contact with the P-38, and several transmissions were interrupted by other calls, it is apparent that Pilot Mendoza did receive the controller's final transmission. The last instructions issued by the controller, which included the message concerning traffic and landing sequence for the P-38, were acknowledged by Mendoza. After receiving this acknowledgment from the P-38, the controller diverted his attention to the other traffic in the area and did not observe the P-38 until the evasive action was taken by the Constellation.

It is apparent that the P-38 pilot did not see the Constellation ahead of him as he entered the traffic pattern, or, if he did see the Constellation it was only when the Constellation was already being maneuvered out of his path. This is reasoned because although the alert tower controller attempted to advise the P-38 pilot, he, without alteration of course, continued to close on the Constellation from the rear at an approximate angle of 45 deg. As the Constellation maneuvered to avoid, the paths of the two airplanes converged until the P-38 was directly behind the Constellation at a distance estimated to be about one city block. This placed the P-38 directly into the area of

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severe turbulence left by the Constellation.

Several comprehensive studies have been made on the problem of turbulence. Beech Aircraft Corp. and the Flight Safety Foundation have been particularly interested in the hazard to flight which can be caused by airplane turbulence. They have published and given wide dissemination to several safety bulletins outlining their findings. The Civil Aeronautics Board has also gathered considerable information on the subject which has been published as a Safety Bulletin and given wide distribution.

All of these bulletins caution pilots that extreme turbulence is caused by wingtip vortices. This turbulence has been reported to have seriously affected aircraft such as the Lockheed Lodestar, Douglas A-20, B-26, and DC-3; and Convair 340, etc. While these reports are primarily concerned with dangerous turbulence encountered during landing and takeoff, they serve to point up the fact that wake or wash following an aircraft can be a serious problem even to large aircraft.

The National Advisory Committee for Aeronautics has conducted a series of flight tests to investigate this matter. It reports[2] that the strength of the trailing vortices of an airplane are mainly dependent on two quantities; span loading (i.e., the ratio of aircraft weight to wing span); and the forward velocity of the airplane. The intensity of these vortices is directly proportional to the span loading and inversely proportional to the aircraft velocity. When the ratio of the aircraft weight to wing span increases, the strength of the trailing vortices increases; when the forward velocity of the aircraft decreases, the strength of the trailing vortices increases. This report concludes that the trailing vortices contain velocities of a dangerous magnitude and represent a region of air similar to severe turbulence. These disturbances can remain in the atmosphere for periods of 30 to 60 sec. and under favorable conditions may not dissipate for somewhat greater lengths of time.

The intensity of this area of turbulence was probably increased substantially when the Constellation "pulled up." The "pull-up" would increase the instantaneous span loading which would result in a corresponding increase in the strength of the trailing vortices.

Many instances have been recorded in which aircraft have experienced uncontrollable rolling when encountering aircraft wake. It has also been shown that this rolling effect is more severe on the penetrating aircraft when its angle of attack is increased. Evidence has shown that the P-38 was in a slight left turn. Because the P-38 was entering traffic, it can also be reasoned that its speed was somewhat less than cruising. Both of these factors would result in a slightly higher angle of attack and consequently a more severe effect from the wingtip vortices.

It is probable that this turbulence caused the P-38 to roll violently. It is also possible that the pilot aggravated the rolling effect by a last-minute reaction to avoid a collision. In either case, it is evident the P-38 rolled in the turbulence to an approximate 90-deg. bank. While in this 90-deg. bank the P-38 pivoted to a vertical nose-down attitude. While the Board cannot determine the reason for this flight deviation, several possibilities are suggested. One, that the violence of the upset from the turbulence was sufficient to temporarily incapacitate the pilot; two, that the flight path resulted from the pilot's evasive action; three, that the aircraft was rendered uncontrollable either by the turbulence alone or because of some inflight structural failure. The latter was not substantiated by any evidence at the scene. In any event, the aircraft reached a vertical attitude at an altitude too low for recovery.

The reason for Pilot Mendoza's failure to see the Constellation in time to avoid its wake is unknown. It is possible that Mendoza was establishing an approach interval with respect to the TWA Martin on the base leg. Since the P-38 was in a slight left bank, the relative position of the Constellation was ahead and slightly below which would have made it difficult to see. It is also considered possible that the pilot's field of vision was further restricted because of the modified nose section on the P-38.

[2]Velocity and Persistence of the Trailing Vortices of an Airplane, Christopher C. Kraft, Jr., Langley Aeronautical Laboratory, NACA conference on some problems or aircraft operation, Nov. 17-18, 1954.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The P-38 aircraft and its pilot were properly and currently certificated.
2. The P-38 approached Pittsburgh at the same approximate time as TWA Flight 160.
3. Both aircraft were at nearly the same altitude on converging flight paths with the P-38 slightly to the rear and above the Constellation.
4. The Constellation pilot saw the P-38 in time to execute a climbing right turn and avoid a collision.
5. The P-38 entered a vertical left bank, either as a result of the pilot's reaction to avoid a collision, or by the severe turbulence of the wing vortices of the Constellation, or a combination of these.
6. The P-38 then nosed down and dived vertically to the ground.
7. No malfunction of the airplane or its components prior to impact with the ground was found.
8. No inflight contact occurred between the Constellation and P-38 and the Constellation landed without further incident.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was due either to aircraft-induced turbulence or excessive control action by the pilot in an effort to avert collision, or both, causing loss of control of the P-38 at an altitude too low to effect recovery.

A contributing factor was the lack of vigilance by the P-38 pilot as he entered the airport traffic pattern.

By the Civil Aeronautics Board:

James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti
Louis J. Hector

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident shortly after it occurred. An investigation was immediately initiated in accordance with the provisions of Section

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702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Depositions, ordered by the Board, were taken in Santa Monica, Calif., September 25; Boston, Mass., September 26; Pittsburgh, Pa., September 27; and Washington, D. C., September 30, 1957.

The operator, Hycon Aerial Surveys, is a subsidiary of the Hycon Manufacturing Co., Pasadena, Calif. Hycon Aerial Surveys operates a fleet of aircraft for the purpose of conducting aerial photography and magnetometry. The company maintains its base of operations at Ontario, Calif. It employs six to eight pilots, several photographers, and, in addition, CAA certificated mechanics to maintain the aircraft.

FLIGHT PERSONNEL

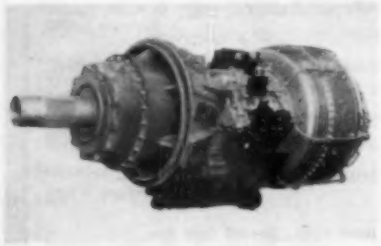
Albert Mendoza, 30, was employed by Hycon Aerial Surveys September 20, 1954. He possessed a currently effective airman certificate with commercial, single- and multi-engine land, single-engine sea, P-38, and instrument ratings. His flight time was recorded with the Civil Aeronautics Administration as totaling 2,600 hr., with approximately 310 in P-38 aircraft. His second-class CAA physical examination was passed August 19, 1957, with no waivers or limitations.

John L. McPherson, age 34, was employed by Hycon Aerial Surveys August 16, 1957, as an aerial photographer. He previously had been employed as a photographer by Fairchild Aerial Surveys.

THE AIRCRAFT

N 69902 was a P-38L manufactured by Lockheed Aircraft Corp. for the U. S. Air Force. The manufacturer's serial number was 8470 and the military serial number was 44-53180. Extensive modification had been made to the aircraft to enlarge and lengthen the nose section to accommodate multiple aerial cameras and a photographer. These modifications were made in compliance with CAA engineering data. The aircraft was subsequently inspected and test flown, and issued a limited category airworthiness certificate. This limitation restricted the aircraft from being used for the purpose of carrying passengers or cargo for hire.

The aircraft had a total of 980 hr. and 52 min. of flying time. It was equipped with two Allison V-1710-91 engines and Curtiss electric propellers, hub models C532D-F-61 and C532D-F-62, blade models 88996-18 and 89303-18.



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Lycoming T53-L-3 turboprop engine has been ordered into production under a $6 million Air Force/Army contract (AW June 30, p. 27). Minimum takeoff power at standard sea level conditions is 960 shp.; 1,005 eshp.

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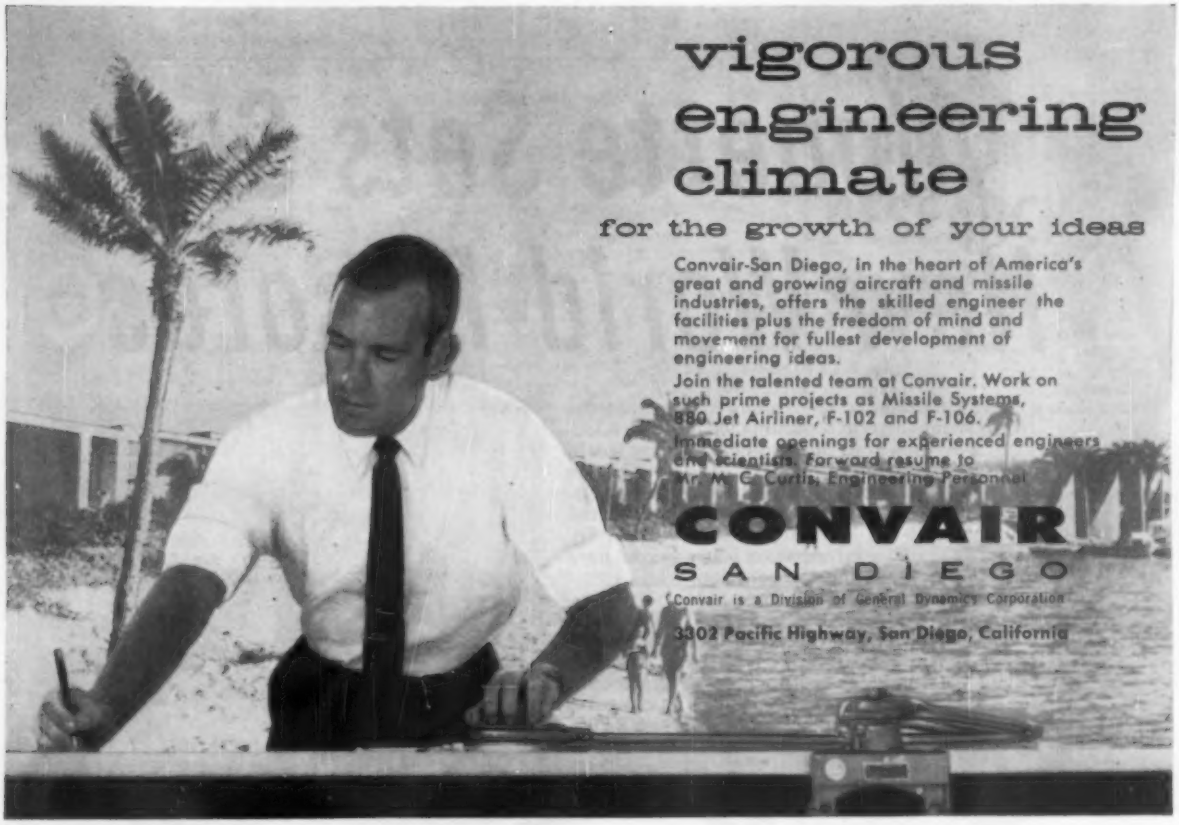
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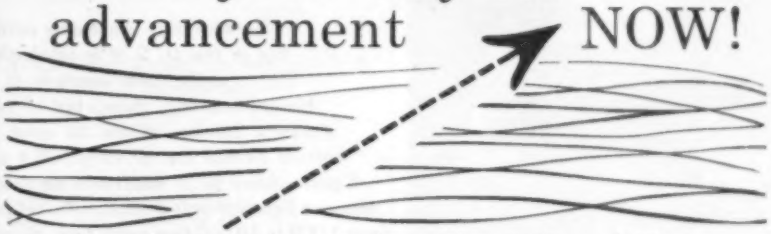

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All six records were set at the French Air Force Test Center, Bretigny, on June 13, a Republic spokesman stated. Included was a record for climbing to 31,267 feet with two passengers, topping the mark for helicopters in the 2,205-lb. to 3,858-lb. payload class.

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LETTERS

Facts and Figures

I have been looking over the copy of AVIATION WEEK in which the 19th edition of "Air Transport Facts and Figures" appears (April 21). I want to congratulate you on the fine reproduction job and while I know that in the past you have done a fine job, I think with this edition—which marks the third year of AVIATION WEEK using "Facts and Figures" as an insert—you have done the best job of all.

The industry appreciates the value of the added circulation given our standard reference of U.S. scheduled air transportation.

STUART G. TIPTON
President
Air Transport Assn.
Washington, D. C.

Flying Going Blind?

I've just read an article by Lt. Cmdr. Laverne W. Dilts, USNR, Naval Supply Depot, Bayonne, N. J., in your June 23 issue of Aviation Week (p. 94). In addition to this article, I've read hundreds of others which all leave me "cold" as none of them seem to get at the real grass roots of the problem.

Just to make it easy for the average man who does not fly his own airplane at his own expense, let's make a comparison between aircraft and roadcraft.

First, let's look at the airplane and automobile as one and the same. They both use roadways; however, they can be broken up into two different degrees. The automobile does not leave the road (supposedly so). The airplane only uses the road for gaining momentum which, in turn, gives it proper air speed for takeoff. On landing it makes contact and decreases momentum to a sufficient degree so that it may be driven as an automobile and parked.

We have different types of carriers.

1. The private airplane and the private car are both for private transportation.

2. We have highway buses and airway buses (generally referred to as airliners).

3. We have highway trucks and we have airway trucks. Both are "freighters."

4. Then we have the police department. This consists of military airplanes of all various types operated by the United States Government, state governments, county governments, and city governments.

All of these segments of transportation should be put into the proper perspective and none should be slighted and, by the same token, should any be allowed to encroach on the others.

We hear much about "high density" areas. As this term is used, it is certainly a misnomer. If you really want to consider a high density situation, let's look at the record when the Piper Aircraft Co. held Open House at Lockhaven, Pa., Aug. 17, 1957, where there is only one airstrip and no traffic control. Hundreds of airplanes of all various types and speeds and all types of drivers were landed up to a rate of 400 airplanes per hour. • Does this not indicate that we are trying to put so many

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

props under our shortcomings that we are actually working overtime to build in troubles for ourselves?

If the average highway bus had no more visibility than the average airways bus for its drivers, we really would create some REAL crashes. It certainly seems to me that visibility can be built into our air buses much easier and more economically than spending millions of the taxpayers dollars for additional "props" to take care of our past mistakes, about which we are sticking our heads in the sand and ignoring like a bunch of ostriches.

After all, when do most all of our collisions happen—clear days and clear nights according to the record. Just because an airplane driver has an automatic pilot and all the other gadgets certainly does not give him any reasonable excuse for not looking where he's going, regardless of the type of equipment he is driving. This goes for highway equipment as well.

Regardless of paint jobs on the aircraft, there is no substitute for using one's eyes and alertness. I wonder if the author would like to have his automobile painted the same way—after all, they collide also. With all the gadgets we're building in to take the work off the poor overworked drivers, I'm wondering "Is Flying Going Blind?"

The same thing applies to red rotating anti-collision lights. One still must look where they're going to see the lights.

We continually scream about the economy of our country; yet, we continually find more and more ways to spend more of the public's money for controls which we already have too many of. The majority of the regulations now being proposed chiefly by armchair pilots and sidewalk superintendents will practically eliminate the use of private airplanes. Let's remember while we're talking economics that the private automobile contributes very materially to our economic stability in this country. The automobile followed the horse and buggy and the horse and buggy followed the ox cart. Now if the private airplane is to be a step further into our progress of transportation, we'd better give it a chance instead of crucifying it in its childhood.

We have done a marvelous job in building airport facilities throughout the country which, in turn, has created more and more taxes for the overburdened taxpayer. But just what have we done about building landing strips throughout the country which could be maintained through the taxation on gasoline and oil for aircraft, and let the facilities for such operations be operated adjacent thereto by free competitive enterprise. The records indicate that we have slipped so far into socialism that we have forgotten that this great country of ours, including all segments of its industry, grew through free competitive enterprise. In conclusion, let's remember that no mechanical device is any safer than its operator. Let's start building some airplanes with some visibility and let's start looking where we're going.

HUGH C. ROBBINS
President
Robbins Aviation, Inc.
Los Angeles, Calif.

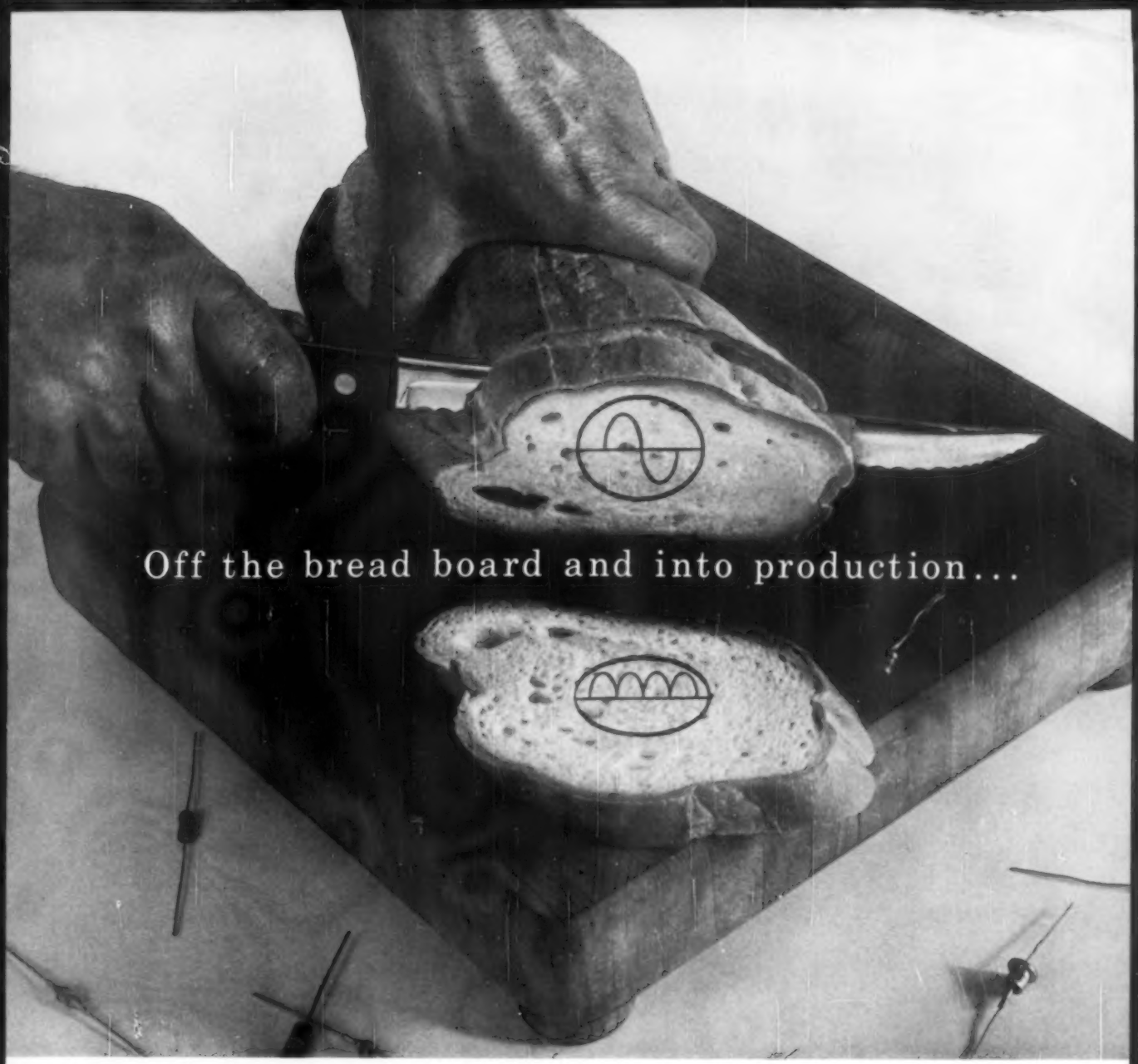
Airborne Monitor

May I express our appreciation of the lucid and accurate treatment of our Takeoff Progress Indicator in your June 23 article "Monitor Designed to Aid Jet Takeoffs", by Philip J. Klass (p. 65). This is another example of the fine technical reporting we have come to expect from Mr. Klass.

I should like, however, to clarify an impression given by Mr. Klass that an airborne monitor such as Kollsman's will not warn of danger if the pilot attempts to take off on too short a runway. Since the available runway length is a factor in determining the rate setting of the Kollsman indicator, if the pilot puts into the rate setting computation the length of the runway which is too short, he will come up with an impossibly high acceleration requirement. If, in spite of this, he still attempts his takeoff, the takeoff bug will immediately run away from the airspeed pointer, thus at once showing the dangerous condition. I believe that the other airborne systems are also designed to signal danger in this circumstance, if the correct data is set into them. HENRY F. COLVIN, III
Chief, Air Data Instrument Section
Kollsman Instrument Corp.
Elmhurst, N. Y.

(There are really two possible situations. The one which Mr. Colvin discusses assumes the pilot takes off from same runway used in slide rule/chart determination of "normal acceleration" value set into monitor, but runway is too short for particular airplane configuration and temperature. Kollsman-type monitor might give adequate warning to pilot if the runway were far too short, so monitor called for extremely high acceleration, but might not give warning if runway was only slightly short of requirements. As the Minneapolis-Honeywell and Sperry monitors are now designed, runway length does not enter into determination of normal acceleration, and they would not provide warning. This factor could be introduced into latter devices or into charts used to determine normal acceleration setting.

(In the other possible situation, pilot selects runway of adequate length for his computation or normal acceleration, but attempts to take off from a different runway of insufficient length because of human error or sudden shift in winds and failure to recompute monitor settings. Under these conditions, none of the three airborne monitors described in the article could warn pilot of hazard, whereas a ground-based system which is tailored to a specific runway would give warning. This is inherent difference between the airborne and ground-based system which AVIATION WEEK's article intended to point out.—Ed.)



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